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ELECTRICAL REVIEW

FOUNDED 1872

Vol. CXXXIII. No. 3447 DECEMBER 17, 1943 6d. WEEKLY

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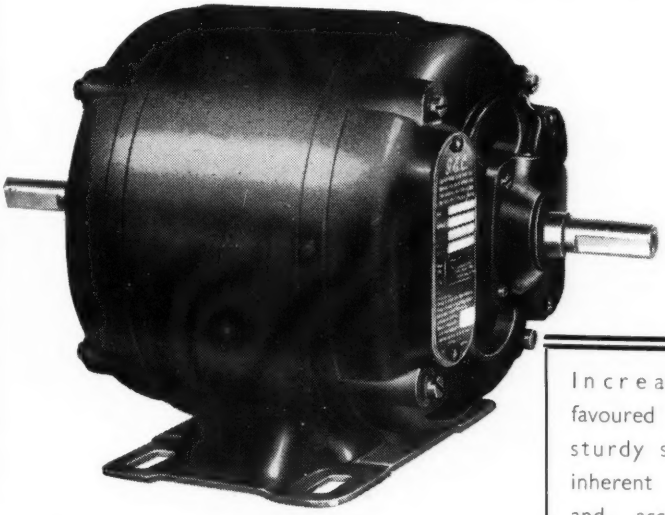

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ELECTRICAL REVIEW

December 17, 1943

Managing Editor:
Hugh S. Pocock, M.I.E.E.

Technical Editor: C. O. Brettelle, M.I.E.E.

Commercial Editor: J. H. Cosens

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ELECTRICAL REVIEW
THE OLDEST ELECTRICAL PAPER — ESTABLISHED 1872

Vol. CXXXIII. No. 3447. DECEMBER 17, 1943 6d. WEEKLY

Fire Hazards

Proper Installation and Maintenance

IN industries which have been rapidly expanded to meet war needs, or which embrace processes specifically intended to serve the same purpose, past experience is often an inadequate guide to the avoidance of accidents such as those that may in some way be associated with the use of electricity. An example of the influence of the present magnitude of operations is to be found in the heavy currents employed for automatic welding in shipyards where, in order to avoid excessive voltage drop at the arc, 400-V transformers are brought on to vessels, which has entailed special stipulations in regard to earthing, as mentioned in our issue of December 3rd. Many of the processes concerned in munitions production appear to be more prone to fire and explosion risks (the aircraft industry provides one instance) than are ordinary industrial activities. Diagnosis is similarly hindered in that causes are usually obliterated by effects.

Collating Experience

Although plenty of scientific data exists regarding the conditions favouring primary ignition of gases, it is not of a nature to enable conclusions of practical value to be drawn. Moreover, secondary causes of ignition are often of greater consequence and these vary widely with local circumstances. Any pronouncements on what constitutes safe practice rest generally on an empirical basis, so that a large number of working or test examples is required for the establishment of a satisfactory code. This need gives a special value to the wide experience of the Electrical Branch of the Factory Department, and the paper which Messrs. W. Fordham Cooper and F. H. Mann presented before the I.E.E. Installations Section last week was certainly opportune.

While adequate ventilation and the elimination as far as practicable of the material likely to contribute to the spread of fire are essentials, the primary insurance against fire risk is the soundness of the installation, as the authors point out, and this extends from the use of flameproof apparatus (including its ancillary gear) down to the choice of flexible cables, and includes the arrangements for earthing portable tools.

Protective Relays

Another matter fundamental to safety considerations is the correct setting of the protective system in relation to the loading of individual circuits and—what is seemingly less often appreciated—the care taken to ensure that the resistance of the earthing circuit is not too high to prevent the operation of the relays in the event of an earth fault.

It is not enough that the original installation should make these provisions. It must be maintained at the same level and any extensions carried out to the same high standards. This is no easy matter with the present dearth of skilled technicians, which the recent report of the Electrical Branch describes as perhaps the most serious aspect of an unprecedented industrial position. In order to preserve a correct per-

spective, however, it should be emphasised that electrical accidents form a minute proportion of all those occurring in factories and that the processes here mainly under consideration are of a special character, involving not only mains electricity but also the unwanted static sort. It is only on account of the relative safety of electrical methods that they are adopted or, indeed, that some of the processes can be undertaken at all.

Minimum Charges

THE decision of the Minister of Fuel and Power to reduce the limit of the minimum charge to flat-rate consumers from 25s. to 10s. per annum must be regarded more as a "gesture" than as a serious relief to consumers. No doubt there are still a few consumers who spend less than 6d. a week on electric lighting and some of these may now get their service for about 2½d. a week. There will be few supply undertakings ruined as a result, and the reduction cannot mean much in the way of fuel economy.

More Sleep, Less Fuel

MAJOR LLOYD GEORGE has considered a suggestion that much fuel would be saved if people went to bed half an hour earlier and said in the House last week that a saving of a million tons might possibly be made in this way. He went on to say that it was between 8 a.m. and 1 p.m. that he wanted to curtail gas and electricity consumption. If it were not for this consideration we would suggest that an extra half an hour in bed at the other end of the day would be more popular these dark, cold mornings.

Strength in Disunity?

HYDRO-ELECTRIC power plays an important part in New Zealand's economy and it is therefore understandable that the shortage which has arisen in the North Island and threatens the South has resulted in criticism of the Government, which controls power production in the Dominion. The supply authorities feel, with some justification, that they should have a say in the provision of sufficient generating capacity to meet their demands. The record of electrical development in the country would, however, hardly seem to warrant the assertion made in a paper presented to the N.Z. Institute of Electricians that centralised control (both as represented by the C.E.B. in England and the Public Works Department in New Zealand) has proved inadequate to cope with the many diverse conditions that arise. Each locality should develop its own resources. Such a course would be a reversal of the general trend and would surely be particularly disadvantageous to New Zealand, where the development of large water-power resources has resulted in the present very cheap and widespread supply of electricity.

Street Lighting

A REMARK by the Home Secretary a few weeks ago caused a stir among public lighting authorities. It was taken to mean that they should be prepared to switch on all street lamps immediately the "Cease fire" sounded. Those authorities who removed and carefully stored all their lamps will probably be able to restore a great part of their lighting in a reasonable time, but there are many who either neglected to preserve their equipment or, having stored it, have suffered loss through air-raids and other causes. Those who find themselves short of lamps should not embarrass manufacturers with immediate demands, for the bulk of the output is wanted for more immediate needs. This applies particularly to electric discharge lamps. In this direction there will be little hope of proceeding with new installations in view of the restrictions imposed by the Discharge Lighting Control Order.

Less Variety

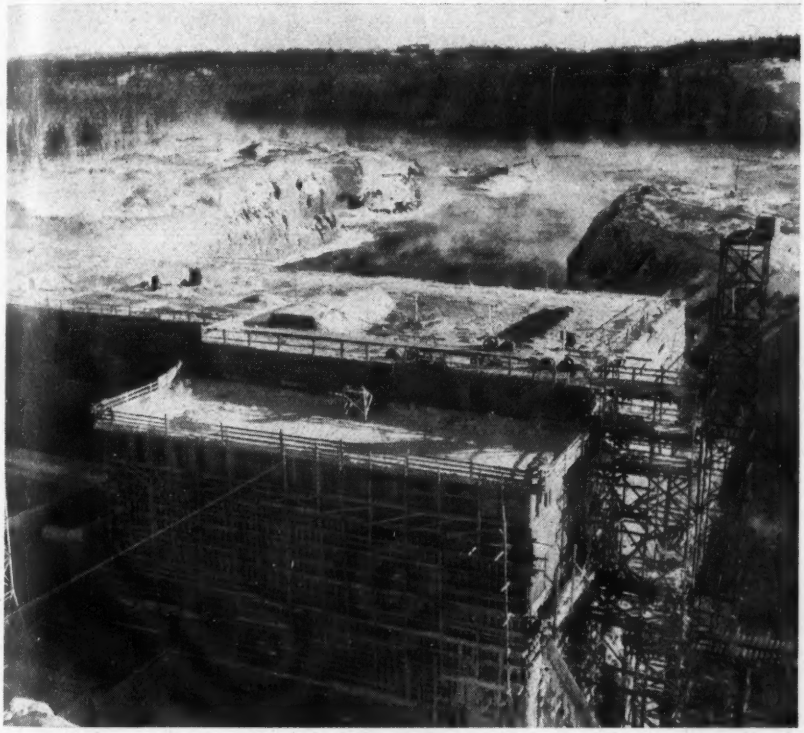
WARTIME necessities have made us do without a good many things and have reduced our choice in a good number of directions. We have made the discovery that this is not always a hardship, for we were really a pampered public before the war. Take electric lamps for instance. In peacetime there were no fewer than 13,000 various sizes and types to choose from; war exigencies have eliminated 9,000 or 10,000 of them and nobody seems much the worse for it. The United States War Production Board announced about a year ago that in America a reduction from 3,500 to 1,700 in the number of types made was being effected. The disparity in numbers in the two countries is evidently due to our variety of voltages.

Shipshaw Development

Canada's Largest Hydro-Electric Scheme

THE new 1,200,000-HP Shipshaw station, situated on the upper reaches of the Saguenay River in Northern Quebec and put in hand with the primary purpose of providing power for the production of aluminium at the Arvida works of the Aluminum Co. of Canada has now been completed. The generating plant comprises twelve 100,000-HP sets, two of which have been transferred, after being rebuilt for a larger output, from the existing Chute-a-Caron station.

The project entailed the raising of the river bed over a distance of one and a half miles, which was done in 1941, the additional fall enabling nearly 50 per cent. more power to be obtained; it also included the building of five dams, including two storage dams on the headwaters of Lake St. John, *viz.* Lake Manouan, which was finished in 1941, and Passe Dangereuse, which was finished in February, 1942. Work on the clearing of the site, the preliminary lay-out and the installation of construction equipment was carried out in the summer of 1941 and the constructional work upon the power station itself was started in the following autumn.



First section of new Shipshaw station nearly complete and adjoining excavation for addition of six further generating units, as seen from head-block

In November, 1942, the first two units were turning over and by August last six were in commission. The remaining sets were due for completion at the end of this year.

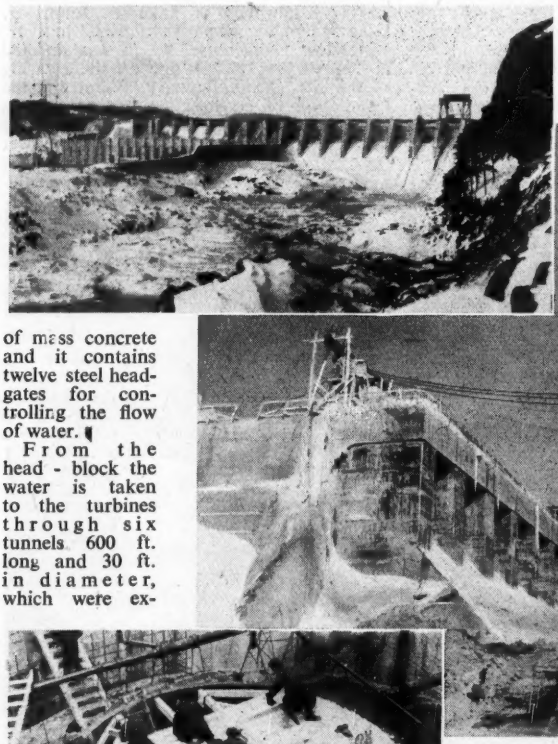
The Saguenay River had to be forced through a canal formed partly by excavation

of solid rock and partly by making concrete banks. This canal is just over one and a half miles long and has a minimum width of 300 ft. and a minimum depth of 33 ft. The intake structure of the head-block at the downstream end of the canal is built of mass concrete and it contains twelve steel head-gates for controlling the flow of water.

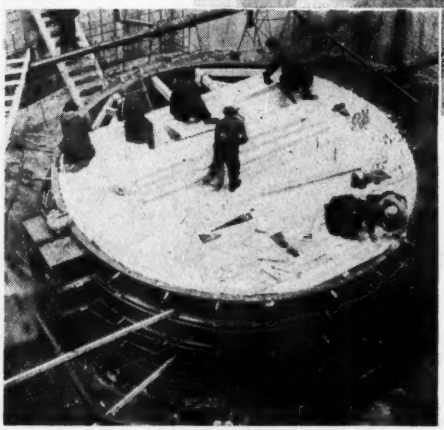
From the head-block the water is taken to the turbines through six tunnels 600 ft. long and 30 ft. in diameter, which were excavated through the solid rock and lined with concrete. The head-block is 90 ft. above the far end of the tunnel. The effective operating head is 208 ft. wide and the water is discharged into the tailrace in the original river bed. The concrete power station building is 800 ft. long.

In order to remove the final barrier formed of 18,000 cub. yd. of rock which separated the tail-race from the Saguenay River, 30,000 ft. of holes were drilled in it, in addition to a number of holes driven under it from the landward side. The holes were loaded with 83,000 lb. of dynamite and one shot sufficed to remove the barrier, part of which was deposited in a natural hole in the river and the remainder in an additional hole which had been provided in the bed of the tailrace.

At the peak of the work 10,595 men were employed. The capacity for concrete mixing was 7,800 cub. yd.



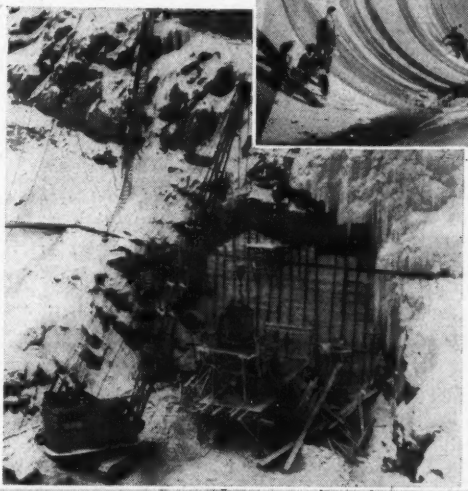
Top : The dam near Chute-a-Caron power station that diverts water to canal for new station. Below : Head-block at lower end of canal just above power station



Part of scroll case of 100,000-HP turbine in the new Shipshaw generating station

per day and the maximum consumption of cement was 31 truckloads. Altogether 525 trucks were in use, 21 of which were of the 20-ton type, and 67 tractors. There were also 44 power shovels.

Capital expenditure on the installation of 1,500,000 HP, including the 300,000 HP at Chute-a-Caron which has been in operation in its several stages since from January, 1931, to January, 1934, amounted to $105,700,000. The relatively high cost of construction is attributed to the speed at which the work was carried out, ahead of schedule, under war conditions. This involved a labour force twice the size of that which would have otherwise been employed, and generally of much poorer quality, and a great deal of overtime. The large number of men employed necessitated the provision of about twice the usual amount of construction plant of all types and of camp buildings. Moreover, the work was carried on during the winter, when normally frost would have prevented progress, by using special equipment.



Above: Welders testing for leaks in tunnel, looking towards head-block
Left: Pouring concrete into 4-ton buckets to be conveyed into tunnel

Below: Excavations for diverting the Saguenay River

Industrial Reconstruction

Engine Manufacturers' Memorandum

AN 87-page booklet has been received from the Internal Combustion Engine Manufacturers' Association setting out that body's views on post-war reconstruction generally and as it particularly affects the internal combustion engine industry. The importance of internal co-operation is first stressed and some methods of bringing this about are suggested. International control and direction of trade is recognised to be necessary during the transition period, but it is thought that it should be abolished later, except in so far as its continuance is found to be necessary and desirable.

Government Plan Needed

Dealing with the necessity of preparing plans now for national reconstruction, the memorandum says that there is a need for a strong Ministry of Reconstruction to work out a provisional plan. Until such a scheme is made known industries will be unable to work out their own plans. It is maintained that industry has proved its capabilities during the war and is quite able to meet world competition in the transition from war to peace, provided it is not hampered by controversies about altering its organisation and control. As in international affairs, Government control should not be retained longer than is necessary. A material revision of the basis of taxation and a speedy liquidation of wartime contracts are considered essential.

The third section of the memorandum gives particulars of the constitution and objects of the Association and its allied bodies and then sets out what are considered to be the essentials for a successful change-over. First it is contended that " break " clauses in Government contracts (which enable the Departments to terminate them after a stated notice) should not be operated so as to cause a stoppage in national production and, secondly, that the disposal of used Government machinery and equipment in home and export markets should be prevented.

Allocation of Materials

The Association considers that so long as there is a shortage of materials the controlling Departments should make " global " allocations of material to the Association for distribution among the members of the industry, as has been done during the war through the industry's Export Group.

Steps should be taken to see that the key men and technicians who have been taken from the industry are returned as soon as possible. To ensure a sufficiency of orders and reasonable assurance of payment all but a normal commercial risk will have to be borne by some Governmental or international authority, especially in respect of orders from devastated countries. Financial assistance may have to be afforded to manufacturers to enable them to meet their " terminal losses."

Reasonable price agreements may be necessary to maintain the stability and continuance of employment in an industry. Research is regarded as essential to post-war industrial and commercial progress. The necessity for improvement in the industry's export sales methods in order to meet the new conditions is admitted. The resuscitation of trade will depend largely on the inauguration of new international conditions.

Other matters relating to export trade which are dealt with include an effective policy for multi-lateral trade; the prevention of Germany from resuming her unfair methods; the development of Governmental organisation for the furtherance of overseas trade; a co-operative policy with regard to the manufacture of internal-combustion engines in the Dominions and elsewhere; and the services which could be rendered by the United Kingdom Commercial Corporation.

The report is introduced in a preface by Sir Lynden Macassey, independent chairman of the Association.

London Students' Papers

THE multi-channel system of carrier telegraphy, which is the standard method utilised by the British Post Office, is described in a paper submitted by Mr. P. J. McMahon to the London Students' Section of the Institution of Electrical Engineers. This system is rendered very flexible by employing existing telephone lines of high grade, so avoiding the necessity for setting up reserve lines which must remain idle while the normal working lines are in good order. Repeating difficulties and limitations are overcome by the use of AC telegraphy, for which carrier frequencies are generated by 18 inductor alternators, each energising 10 channels, all mounted on the same shaft and driven by the same motor with common field excitation.

The nature of sound and some of the factors involved in its transmission are dealt with in a paper read by Mr. K. J. Easton before the Section. Details are given of the energy range and spectrum of the human voice, since telephone engineers are particularly concerned with the characteristics of speech. The performance of a telephone line is described with the aid of a mechanical analogy and an account is given of those factors that cause frequency distortion ; it is shown that the electrical characteristics of the circuit are determined by the four " primary constants," which are conductor resistance, capacitance, inductance and leakance.

Factory Maintenance

Points Needing Attention

By J. Southern

PRESENT-DAY conditions provide the maintenance engineer with an exceptional opportunity to widen the scope of his experience from the technical standpoint. With the introduction and now almost universal adoption of self-contained machine tools there has been developed an ever more intricate and comprehensive scheme of automatic control gear that calls for the most intense study before it can be mastered.

As the old adage has it, prevention is better than cure, and it behoves the maintenance man to understand thoroughly the plant under his charge so that he can intelligently anticipate its weaknesses and shortcomings or, having suffered from a breakdown, take the necessary steps to prevent a recurrence. For instance, on standard AC supply, in how many cases does an operating coil fail through a fault in the winding? Not one in a hundred; yet coils are frequently replaced without making sure that the iron circuit is in correct alignment, with armature face dead flat, the copper shroud complete and no play in the hinge pins. Unless these points are attended to overheating and breakdown of the coil will surely follow.

Contactor contacts are on occasions found to be fitted badly on one phase, which usually means that the three phases are not making or breaking together and a permanent cure for that class of fault is indicated. Due to the absence of intelligent anticipation of the latter, carbon deposits and charring take place on the insulating material, with subsequent rupture and damage to moulding.

Advantage of Separate Control Gear

The widespread use of plastics, while contributing to the neat and tidy appearance of switchgear, certainly does not lend itself to making up a replacement without much expenditure of labour. It is recognised, of course, that standard equipment cannot be expected where each manufacturer has his own design, but it would be most helpful if control gear were fitted as a separate unit and not as an integral part of the machine, thus enabling similar types of gear to be used to replace any defective part quickly.

Then there is the question of connection diagrams for control gear and the best means of ensuring that some permanent record is available on the spot. The practice of fixing a print inside the starter cover is not always a happy one, for who has not suffered at some time or another from scorched or shrivelled and otherwise undecipherable diagrams? Some manufacturers have thoughtfully provided permanent records in the form of beautifully engraved plates in brass and bakelite, while others have them cast on the covers. Undoubtedly the last is the best arrangement and when more normal times arrive it is hoped this will become the common practice.

Position of Motor

The position selected for the motor in many machines is unfortunate, as much dismantling has to be done before the motor can be inspected. As this is quite outside the province of the greaser, regular attention means expensive maintenance and rarely is warning given of an impending breakdown, any unusual sounds from the motor being lost in the noise of general machine operation. Without doubt the best position for the driving unit is on top of the gear box, where it is easy to get at, free from swarf, and entails only one lift to clear the gear box for examination; it is pleasing to note that some manufacturers are adopting this arrangement. Further, with such a fixing a temporary drive can be improvised with a motor of other manufacture in the event of a breakdown, and thus save a complete hold-up in production during a repair.

It is obviously impossible to keep a stock of spare motors for every machine which may break down, and many maintenance engineers of the old school look back with regret to the shaft-drive system, despite its forest of belts and dust-laden atmosphere. In those days he was happy in the knowledge that a small stock of motors and starters was sufficient to cover all eventualities; a change-over could be effected in less than an hour and was usually left to a mealtime break, unless an actual stoppage occurred. Nevertheless, the indirect advantages of unit drives, that is, better lighting facilities, cleaner atmosphere and elimination of live-belt danger, ensure that this system has come to stay, and the maintenance man has to make the best of it.

Sleeve and Race Bearings

Many queries are raised concerning the best type of bearing, whether plain or race, and, though the latter is the more common to-day, each has its own application. Where silent running is required the plain or sleeve bearing holds the field; it is easily and speedily re-metalled and, if given regular attention, will last indefinitely. Oiling, of course, must be attended to and care taken to see that oil rings are running freely. A motor

with such bearings in some inaccessible position, such as a machine tool casing, would soon be in trouble and therefore a ball or roller race is selected and this may engender a feeling of false security.

The validity of the claim that races require attention only at long intervals, six months or more, depends on the conditions of service. Where the surrounding atmosphere is loaded with fine grit which works its way into bearings, once a month is not too often to examine and clean them; again, bearings in high ambient temperatures soon lose their grease, as it is reduced to the consistency of thin oil, thus entailing frequent visits to ensure that they do not run dry. To lay down any hard and fast rules on this matter would be extremely difficult, but my experience is in favour of " little and often."

One of the greatest difficulties to-day when motors of many different makes have to be maintained is the provision of spares for races. As ball races do collapse frequently at short notice it is high time that some recognised standard was adopted, so saving much vexatious delay.

Switchgear Troubles

Industrial-type switch and fuse gear, though usually well designed as to contacts, sometimes suffers from weakness of insulation on the switch bar, a source of frequent breakdowns. Likewise the make-and-break mechanism is not always up to its job. Another weakness arises from the terminals being usually drilled to take the largest size cable for the capacity of the switch, so that when anything less is used full contact is not assured with the clamping screws and overheating takes place. Even manufacturers when fitting the connection between switch and fuse fail on this point. The remedy, in the absence of a cable socket, is to bind the cable ends with wire until the necessary fitting size is obtained, a simple but often neglected precaution.

Of fuse units much might be written relative to standardisation and though the high-rupturing-capacity type is the nearest approach to this and is strongly advocated for the higher capacity of feeder circuit, of 100 A and upwards, the rewirable fuse, considering the number to be replaced daily, is likely to remain in general use for a long time to come.

One of the most important points the maintenance engineer has to consider is the services to machines in the middle of a floor with probably a crane overhead. Any system adopted must be flexible inasmuch as, in these abnormal times, machine lay-outs alter from week to week.

Surface work on floor level is out of the question while to run in ducts means the use of lead-covered cable on account of the oil and swarf which lie around, and this would involve scrapping valuable material when a change round takes place. One method which has proved very satisfactory up to now has been to arrange conduit runs in the floor, similar in principle to carcase work in large office buildings, care being taken to joint all connections thoroughly. Junction boxes are brought to the surface at the most suitable feeding points where services can be made off and all exposed parts protected against mechanical damage by castings.

Plant Lay-out

When dealing with plant lay-outs the importance of one matter is not always fully appreciated—that the maintenance engineer should be represented on the planning committee which deals with the purchase and lay-out of new plant. None is in a better position to advise on the most suitable types of motor or switchgear than the man who has to maintain it, and much valuable production time could be saved by following his advice. By such an arrangement some effort at standardisation could be made with a consequent reduction in range of spares to be carried, maintenance cost and production time lost. Similarly, it is preferable for the maintenance department to carry out the installation of new plant, always provided that the size of the plant justifies a staff of such numbers that one or two can be kept continuously on new work and that their strength can be augmented by borrowing from the maintenance staff when a large job is to be done. By such methods fittings become standard throughout the factory and replacements simply a matter of routine.

With DC fast disappearing, no longer can rotary convertors be relied upon for assistance in power-factor correction and with the modern trend of splitting up large plant into smaller units for safety's sake, an auto-synchronous motor would be of too small a capacity to have much effect. The remaining alternatives are to install static condensers in large banks near the switchboard (since they would be too small to be economical on the motor itself) or to use a rotary condenser. The maintenance engineer will be inclined to favour the latter as this unit is at least something which can be repaired; when a static condenser breaks down, one can only get another.

Cable Marking

WHITE, black, yellow and blue inks for indelibly marking sleeving made of, and cables insulated with, polyvinyl chloride are now marketed by Rejafix, Ltd., 75, Baker Street, London, W.1. The marking is quickly carried out without harming the surface of the cable insulation or sleeving and is said to be proof against both oil and petrol.

PARLIAMENTARY NEWS

By Our Special Reporter

Electricity After the War

IN the House of Commons on December 7th, during the debate on post-war reconstruction, Mr. Barnes, from the Labour front bench, urged that, after the war, electrical development should be placed under public control. He said he had watched electrical development in this country over a long period. He observed its periods of chaotic development under the motive power of private enterprise. He had observed that, to the extent that public interest had been imposed on the electricity industry, both industry and the community had benefited. Public policy had produced the grid, and municipal policy in the field of electricity had developed cheap electricity for the homes of the people.

Mrs. Beatrice Wright pleaded for the more speedy development of electricity in the rural areas. The installation of electricity would greatly simplify the problem of rural water supplies, she said. It was far more economic to carry wires than pipes, and a farm would have added benefit if it had installed electricity for pumping its water as well as being able to use it for lighting, heating and cooking. She saw no reason why pumps should not be standardised and made in large quantities and serviced regularly. They should be obtainable on loan or bought outright.

As to electricity rates, there were 600 to 700 non-statutory bodies with rates varying from reasonable ones to others which were prohibitive. It had been said that it was uneconomical for a county council or local authority to take over the distribution of electricity. Yet in the county of Dumfries the county council had taken electric wiring free to any dwelling house in the county where it was desired. This had not only been a physical benefit to the community, but it had proved economically sound.

Sir Wm. Jowitt, Minister without Portfolio, replying for the Government, said that the development of rural electricity supplies did not come as a new idea. A great deal of work had been done on it by the Government and, when the time came to deal with the matter, much useful information would have been obtained.

Scientific Use of Coal

Mr. Salt asked the Lord President of the Council if he was yet in a position to make any statement as to the action which it was proposed to take to increase research activities for the better utilisation of coal in this country on the lines of the report recently issued by the Parliamentary and Scientific Committee, a copy of which had been sent to him.

Mr. Attlee said he hoped to be able to make an announcement at a later date. He could, however, say now that plans were being made by the Department of Scientific and Industrial Research for the development after the war, on a national basis, of scientific and industrial research. These plans would include the development of research on fuel, including the utilisation of coal, by the Government's Fuel Research Organisation and by industrial organisations. The Standing Consultative Conference on Fuel Research set up by the Department of Scientific and Industrial Research, which had now started its work, would co-ordinate the work of Government and industrial organisations on fuel. The British Coal Utilisation Research Association, the Gas Research Board, the British Electrical and Allied Industries Research Association and other research organisations, which were already receiving grants from the Department of Scientific and Industrial Research, were planning to expand their research activities on the utilisation of coal. Further grants, to other bodies, were now under consideration.

Fuel Economy

Sir Percy Hurd asked the Minister of Fuel and Power if he had considered the suggestion recently sent to him that the public should be told that by going to bed half an hour earlier each evening for the next few months they would save enough coal in the form of electricity and gas to remove all anxiety about the adequacy of supplies for munitions and the great offensive.

Major Lloyd George said that the suggestion had been examined but while the annual saving in fuel that would result if everyone went to bed half an hour earlier might be of the order of a million tons of coal a year—a very valuable saving—only a relatively small amount of this total would be in the form of gas and electricity. Such a saving would not relieve anxiety in regard to these fuels, especially as the greatest demand for electricity was in the morning. Publicity from his Department was therefore being directed first towards the need for general economy in the use of fuel, and secondly towards economy in gas and electricity, in the latter case particularly between 8.30 a.m. and 1 p.m.

Forthcoming Events

Institution of Electrical Engineers.—*South Midland Wireless Group.*—Tuesday, December 21st, 6 p.m. James Watt Institute, Birmingham. "Enemy Airborne Radio Equipment," by Mr. C. P. Edwards.

North-Eastern Students' Section. — Friday, December 17th. Mining Institute, Newcastle-on-Tyne. "Electrical Power in Steelworks," by Mr. R. J. Fothergill. (Joint meeting with N.E. Coast Institution Students.)

Association of Mining Electrical and Mechanical Engineers.—*South Wales Branch.*—Saturday, December 18th, 5 p.m. South Wales Institute of Engineers, Park Place, Cardiff. Informal talk on "Fuel Economies." Mr. E. K. Regan will open the discussion.

Yorkshire North-West Branch. — Saturday, December 18th, 3 p.m. Strafford Arms, Wakefield. "Maintenance and the Designer," by Messrs. Elliott and Stringer.

Junior Institution of Engineers.—Saturday, December 18th, 2.30 p.m. 39, Victoria Street, London, S.W.1. Presentation of awards and induction of Sir Maurice Denny as president.

Post-war Homes

Wide Scope for Electrical Service

ON Friday last week Mr. Alfred C. Bossom, F.R.I.B.A., M.P., who has just returned from a three-months' visit to the United States to investigate housing and building methods there, gave the Electrical Association for Women some ideas for the more extensive use of electrical equipment in homes after the war. Ten million women in England, he said, spent more than half their time in the kitchen, yet only recently had any intensive study been made of planning it properly. There was not universal acceptance of the electric cooker, but with a horizontal arrangement, readily accessible ovens, doors of transparent plastic and thermostatic control, the problems of cooking were materially reduced.

Preserving Foodstuffs

To-day it was readily possible, at no great expense, to introduce an electric dish-washer into the home, and a refrigerator with ample capacity, not too deep, and with transparent doors, would be a welcome addition to a home, not only because it kept things in good condition until required, but because it also saved money by enabling larger quantities of perishable goods to be bought at a time. A further interesting development in America was an ice-cooled roomlet of about 3-ft. cube, which for a little more than a shilling a week the housewife could rent to store foodstuffs. Thousands of these roomlets were being built in groups of from 500 to 1,000. A clothes-washing machine was not an elaborate piece of apparatus, nor unduly expensive, but for the "working class" home it was rather questionable whether the unit that could be used by many families was not more desirable.

There should be a plug point for a vacuum cleaner in each room, and sewing machines were now available which not only sewed but had attachments for stitching on buttons and darning socks, etc. There were also, of course, the electric hair curler and razor.

For the kitchen there was a device which would peel and mash potatoes, beat eggs, string beans, scrape carrots and other root vegetables, mix puddings and, in fact, do a dozen time-taking culinary services. A refuse disposal unit ground garbage so fine that even bones could be washed down the sink.

The Ministry of Works had practically decided that a 10 ft. by 8 ft. kitchen should be the standard size in smaller homes, and into this space there was no difficulty in putting all of these appliances, as well as ample cupboards.

Most people Mr. Bossom considered, would prefer wall plugs for lighting purposes, rather than pendants that never seemed to give light in the place wanted. They would also like the necessary connections for radio and television. There should be unlimited hot water from a central heating plant to serve each district, and even district heating.

In many places in the United States it was usual to include the cost of electricity consumed in the rent, but where that was done much of the apparatus employed was not installed by the landlord. Connections were provided in the general planning, and the appliances, being of standard or stock type, could often be obtained on hire-purchase and taken from one flat or house to another. This meant that voltage and system of supply must be universal in the country where they were used, as was not yet the case in Great Britain. Most women would agree with the six-point post-war programme which Mr. E. E. Hoadley, chairman of E.D.A. proposed for the standardisation of voltages and forms of tariff, facilities for hire-purchase and maintenance of apparatus, development of the industrial off-peak load, technical help for industrial consumers, and increased facilities to the public for advice and guidance.

To carry these proposals out, however, would entail a larger supply of electricity all over the country than was at present available, lower charges, and some adjustment in the general grid lines. The standardisation of voltage would cost about £17 million. The industry, he was assured, would be willing to assume this charge, and in due course would repay it.

Supplementing Water Power

IT has been suggested in some quarters that steam power stations should be constructed to relieve the power shortage in New Zealand, in view of the longer time required to complete hydro-electric projects.

At a recent meeting of the Auckland Electric Power Board the general manager stated (according to the *New Zealand Electrical Journal*) that he had received a cable saying that a complete steam-electric plant of 25,000, 30,000 or 50,000 kW capacity could be delivered within two years, subject to the New Zealand Government certifying essentiality and the British Board of Trade permitting the use of the necessary materials.

Discussing the coal position recently the Minister of Mines estimated that between 500,000 and 700,000 tons would be obtained by lowering the level of Lake Kimihia, near Huntly. The mine would be practically an open quarry, and the cost, including that of lowering the lake, would be far less than in the case of ordinary mining.

Fire Prevention

Safety in Electrical Installations

THE paper on this subject by Messrs. W. Fordham Cooper and F. H. Mann to which we referred last week was read at a meeting of the Installations Section of the Institution of Electrical Engineers on December 9th. Sir Wilfred Garrett (Chief Inspector of Factories), in opening the discussion, said that this country, as a whole, had a good record as regarded loss of life in large fires as compared with other countries, but eternal vigilance was still required. Referring to the increasing use of petrol, especially in aero engine factories, and the danger of fires being caused through electricity, he said that a code of regulations to deal with these risks was now being discussed with the interests concerned. Researches carried out under the direction of Mr. Swann had shown how easily magnesium and aluminium powders could be electrified. A great difficulty was to prevent secondary explosions. With the Mines Research Board, his Department was carrying out experiments at Buxton in an endeavour to find a method of controlling the primary explosion and so preventing the secondary explosion and tests had been carried out by another Department for the control of secondary explosions due to war risks. Ventilation played an important part.

His electrical advisers thought that much more attention should be given to earth leakage; the quantity of current involved might be 50 or 100 A.

Dust Explosion Risks

Mr. G. R. Stanbury, speaking for Prof. G. I. Finch, F.R.S., suggested that the question of flash points and ignition temperatures of vapours and tests required a little more publicising. He welcomed the emphasis in the paper on explosion risks of dusts and said that the limits were very much wider than in the case of liquids. Every care should be taken to keep floors clean and free from accumulated layers. Prof. Finch expressed the hope that the contact that had been established between the Fire Research Division of the Ministry of Home Security and the Ministry of Labour would continue.

Mr. H. Nimmo (Electricity Commission) regretted that switch and transformer oil-fire risks had been given a very small space in the paper. The authors, however, had generally endorsed the recommendations of the Fire Risks Investigating Committee which was set up following the disastrous fire at Bradford. Although drainage sumps were recommended, the authors did not say where they should be located; the tendency in modern power station practice was to have them outside the building. As regarded the suggested provision of drainage sumps filled with clean washed pebbles or ballast, he did not think it was necessary to have the finer aggregate at the top because in the conditions mentioned the flames would be extinguished owing to the lack of oxygen. That was proved in the Bradford fire. Nor did he agree with the suggestion that where possible cables should be led out of the switch or transformer enclosure overhead rather than in trenches; cables which might be exposed to dangerous oil fires should be run in trenches. Finally, Mr. Nimmo said that the development of oil-less switchgear seemed likely to make rapid progress in the post-war period but where oil-filled equipment was installed it was imperative to have automatic fire extinguishing equipment.

Mr. W. R. Watson discussed fire risks in aircraft factories and said that, whilst these risks were now appreciated, it was very difficult to make important changes to meet them without seriously interfering with production. It was essential that there should be an efficient organisation for coping with fires.

Cables in Service

Mr. S. W. Melsom, referring to the use of iron pipes, said that with a bad joint a 5-A arc could produce a serious fire; would it not be better to use clay pipes which would not be able to set up and feed an arc? The authors had given a completely false picture with regard to cable use and cable dangers to-day. All forms of artificial light, heat and power carried certain risks but the risks with electricity were fewer than with any other form. The cable experiments mentioned in the paper were not the sort one would expect in general electrical practice; the results obtained looked extraordinarily bad and gave a wholly misleading picture of what cables actually did in service.

Although the authors condemned cleat wiring—and no one would advocate it except in wartime—he knew of an installation put in after the last war which was still in existence, and he had been told by Government officials that they considered it the safest system of wiring. The authors were not consistent in their comments on t.r.s. cables. There had been many years' experience and a classification of the various systems had shown the results obtained with t.r.s. to be very nearly the highest.

Mr. E. B. Hunter said that, as evidence was usually destroyed by the fire, it was necessary to find out what was really happen-

ing in the installation. Many troubles were caused by earth leakage and, in turn, this was due to lack of maintenance. A good installation was put in in the first instance, but subsequent additions made it unsafe. Something would have to be done to ensure that those who did electrical wiring were capable of doing it, and that the material used came from are liable source.

Many troubles were caused by electric irons. People were too prone to disconnect at the iron itself instead of switching off. While cleat wiring was not in itself a fire risk, it could be the means of carrying a fire—not electrically caused—from one part of a premises to another.

Mr. J. F. G. Smith, an architect, said he wished somebody in the electrical profession would persuade the architectural profession to employ electrical consultants and not rely on specifications which were circulated among contractors without proper supervision.

Maltreated Flexibles

Mr. H. A. Searle said that one of the greatest risks in aircraft factories was in the flexible cables supplying various machines and apparatus. There was a great deal of " green " labour in these factories under war conditions and no care whatever was taken to prevent these flexible cables from being damaged. The electric drill was particularly prominent in this connection.

The main risk in aircraft factories was towards the end of the assembly line when the aircraft was covered with linen which had been doped or was being doped and when the tanks were either being filled or had been filled with petrol. There were great risks here from an electric spark due to a bad connection or loose coupling. He would appreciate any remarks by the authors which would indicate the best means of earthing the air frame of a plane during the process of production.

Mr. S. W. Richards said that, whilst he agreed generally with the authors' suggestions as to the use of flameproof apparatus where dust was the only hazard, he disagreed with the suggestion of greasing the flanges. This might constitute a danger in that the force of an explosion might be sufficient to blow out flaming particles of grease. After assembly the flanges should be painted over or covered with adhesive tape. That prevented an inrush of dust and also maintained the cooling effect of the flameproof flange.

There was only one British Standard Specification that referred to flameproof apparatus outside the mining industry. There were nine referring to the mining industry, and it was rather surprising to notice the difference in the apparatus required in the two cases. The main difference was in the joint tolerance, and the main difference between Group I and Group III mentioned in the paper was only 0·0001 in. The time had come when this grouping system should be abandoned and a general tolerance provided for manufacture—say the 10 mils of Group II. The permissible gases could be marked on the certificate so that the user would know whether he was safe in using a fitting. The authors referred to armoured lead-covered cable connections for flameproof apparatus but it was really unnecessary to have a lead covering.

Major Hogg, speaking of precautions taken in a large factory some time ago where hydrogen was being manufactured and large quantities of petrol had to be handled, said that the safest motor was found to be a totally open machine, because with proper ventilation there was no danger from an electric spark. The real danger was a broken hydrogen pipe and then the only thing to do was to blow in nitrogen at high pressure. When hydrogen escaped in this way at 200 atmospheres there was some effect due to the broken edge of the pipe and the hydrogen flared up immediately. Where flameproof motors had been necessary they were put in a specially built house. If the motor was made dust tight, when it cooled down air would be sucked in through the bearings.

Mr. W. H. Brooks disagreed with the use of cleat wiring. A great deal had yet to be learned about earth protection, particularly with the new type of circuit-breaker which had come in during recent years. Only by efficient planning by an engineer was it possible to ensure economic maintenance.

Inadequate Earth Wires

Mr. R. H. Rawll (Birmingham) said that two rather important causes of fire had not been mentioned. One was where earth wires in industrial premises were cleated into wood or other inflammable material. The wire became heated and charred the wood or other material and so started a fire. The other causes existed more in the past than to-day and it was particularly noticeable on DC systems where, instead of having distributors with the three or four cores in one cable, there were three or four distinct cables laid in a row. There had been cases where the consumer had a works some distance from the point of supply and that meant running three wires from the point of entry back to the power station. The third wire was neutral and there might be a link at the service end. In some cases the neutral wire was very small in section. An incipient fault would occur on that wire and a neutral fault was a difficult thing to find, especially if it were on the consumer's premises and was backed up by a link and there might be serious consequences. Therefore neutral wires should be of adequate section.

The authors had only time to make a few comments by way of reply.

AC Vector Notation

The Symbolic Method and Use of the Operator j

By A. G. Powell, A.M.I.E.E.

THE best appreciation of the symbolic method of vector notation and the use of the operator j applied to AC calculations can be obtained by considering simple examples illustrating the principles involved.

Taking first the case of a series-parallel circuit as shown in Fig. 1; dealing with branch B, the resistance of which is 20 ohms and the inductive reactance $2\pi \times 50 \times 0{\cdot}1$ ohms, the impedance Z_B of the branch is represented by the expression $20 + j31{\cdot}4$ ohms. It should be noted that as the impedance is considered as a voltage drop, the sign applied to the j term is, in the case of an inductive impedance, positive.

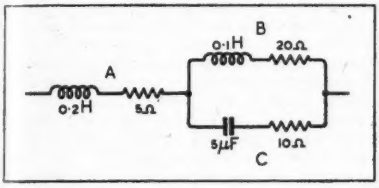


Fig. 1

The admittance Y_B is the reciprocal of the impedance $= \frac{1}{Z_B} = \frac{1}{20 + j31{\cdot}4}$. Rationalising this by introducing the conjugate $20 - j31{\cdot}4$,

$$\frac{1}{Z_B} = \frac{20 - j31{\cdot}4}{(20 + j31{\cdot}4)(20 - j31{\cdot}4)} = \frac{20 - j31{\cdot}4}{20^2 - j31{\cdot}4^2} = \frac{20 - j31{\cdot}4}{1386} = {\cdot}0144 - j{\cdot}0226 \text{ mhos.}$$

Dealing in the same way with branch C, the resistance = 10 ohms and the capacitive reactance $= \frac{1}{2\pi \times 50 \times 5 \times 10^{-6}} = 634{\cdot}9$ ohms. The impedance Z_C is therefore $10 - j634{\cdot}9$ ohms, and the admittance Y_C of this branch $= \frac{1}{10 - j634{\cdot}9} = \frac{10 + j634{\cdot}9}{10^2 - j634{\cdot}9^2} = {\cdot}000025 + j{\cdot}00157$ mhos. The combined admittance of these two branches $Y_B + Y_C = ({\cdot}0144 - j{\cdot}0226) + ({\cdot}000025 + j{\cdot}00157) = {\cdot}014425 - j{\cdot}021$, and the combined impedance in parallel $= \frac{1}{{\cdot}014425 - j{\cdot}021}$

$$= \frac{{\cdot}014425 + j021}{{\cdot}014425^2 - j021^2} = 22{\cdot}3 + j32{\cdot}5 \text{ ohms.}$$

The resistance of branch A = 5 ohms, and the inductive reactance $2\pi \times 50 \times {\cdot}2 = 62{\cdot}8$ ohms; the impedance $Z_A = 5 + j62{\cdot}8$ ohms.

The total impedance of the whole circuit $= (22{\cdot}3 + j32{\cdot}5) + (5 + j62{\cdot}8)$ ohms $= 27{\cdot}3 + j95{\cdot}3$ ohms $= \sqrt{27{\cdot}3^2 + 95{\cdot}3^2} = 99$ ohms. The current at 230 V would therefore be 2·3 A, and the angle of lag arc $\tan \frac{95{\cdot}3}{27{\cdot}3} = 74$ deg.

A further example is the determination of the phase and neutral currents in a three-phase four-wire system. Assuming the simplest condition of balanced voltages and with circuit constants as in Fig. 2, taking A as the reference phase voltage and the phase voltage as V, then B phase voltage $V_B = V\left(-\frac{1}{2} - j\frac{\sqrt{3}}{2}\right)$, as B is 240 deg. anti-clockwise to A, and C phase voltage $V_C = V\left(-\frac{1}{2} + j\frac{\sqrt{3}}{2}\right)$ as C is 120 deg. anti-clockwise to A.

The phase impedances are:—$Z_A = 2 + j1$, $Z_B = 1 - j1$ and $Z_C = 2 + j2$.

The phase currents in terms of the reference voltage vector are:—

$$I_A = \frac{V_A}{2 + j1} = \frac{V}{2 + j1} = \frac{V(2 - j1)}{5} = V({\cdot}4 - j{\cdot}2).$$

$$I_B = \frac{V_B}{1 - j1} = \frac{V\left(-\frac{1}{2} - j\frac{\sqrt{3}}{2}\right)}{1 - j1} = \frac{V\left(-\frac{1}{2} - j\frac{\sqrt{3}}{2}\right)\left(1 + j1\right)}{2} = V({\cdot}183 - j{\cdot}683).$$

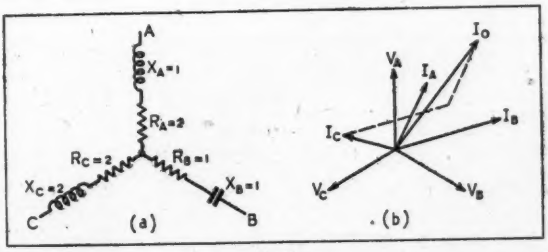


Fig. 2

$$I_C = \frac{V_C}{2 + j2} = \frac{V\left(-\frac{1}{2} + j\frac{\sqrt{3}}{2}\right)}{2 + j2} = \frac{V\left(-\frac{1}{2} + j\frac{\sqrt{3}}{2}\right)\left(2 - j2\right)}{8} = V({\cdot}09 + j{\cdot}34).$$

(*Continued at foot of next page*)

Fuel Research

Past Achievements and Future Work

IN an address to the Institute of Fuel in Newcastle-upon-Tyne on Monday last Dr. A. Parker, Director of Fuel Research, Department of Scientific and Industrial Research, said that the outstanding scientific and technical achievements of this country, especially during the war, had proved beyond doubt that our scientists were at least equal in ability to those in any part of the world. Though the quality of our scientific work was not surpassed anywhere, we had lagged behind some other countries, for example, Germany and the United States, in the amount of research. The value of scientific research had not been sufficiently recognised and in consequence the number of trained scientists in this country had been relatively small. If we were to occupy a prominent place in world affairs after the war, there must be a great expansion in the amount of our scientific research and in the application of science in industry.

It was during the last war that the Government gave a lead by establishing the Department of Scientific and Industrial Research. One of the first activities of the new Department was to set up the Fuel Research Board to investigate in the broadest national interest, the nature, preparation, utilisation, and treatment of coal and other fuels, and their products. Nowhere else in the world was there at that time an organisation on quite the same lines.

Experimental Equipment

To-day, this organisation, with a staff of more than 250, includes the central Fuel Research Station equipped not only for experiments in the laboratory, but also for experiments on a semi-commercial scale and on a full commercial scale. The full-scale units included plants for cleaning, drying and pulverising coal, for the manufacture of fuel gases, hydrogen and coke, and there were full-size boilers of several kinds. Much experimental work had been undertaken not only at the Fuel Research Station but also at industrial works in co-operation with industry.

In addition there were nine Coal Survey Laboratories in various parts of England, Scotland and Wales which had been undertaking, in collaboration with the Geological Survey of the Department, a comprehensive survey of the qualities of the national coal resources. Without such information economic planning of the use of the coal reserves in the future would be impossible. Planning of this kind was of great importance because some of the coals with special properties were limited in quantity and on this account should not be used for purposes for which other more abundant coals were suitable.

After referring to some of the achievements of the Fuel Research Organisation, Dr. Parker said that if this country was to maintain its position in industry, we must rapidly develop our scientific and industrial research in relation to coal and other fuels, in the widest national interest, and we must show initiative and enterprise. It must no longer be true to say that our scientists made the fundamental discoveries, while we left other countries to develop and apply them in industry.

Mutual Assistance

There must also be a spirit of mutual help in research, involving friendly discussion and collaboration between the scientists in Universities, in Government establishments, industrial research associations, and other research organisations. A good beginning in this direction had already been made. The Department had set up a consultative conference on fuel research, which was attended by representatives of the Iron and Steel Industrial Research Council, the British Refractories Research Association, the British Electrical and Allied Industries Research Association, the British Coal Utilisation Research Association, the British Hard Coke Research Association, and the Gas Research Board.

Dr. Parker concluded with a warning. He said that where there was a lack of the real appreciation of the conditions under which successful research was carried out, there was an impression that if large sums of money were provided for research, marvellous discoveries would follow as a matter of course. While adequate financial provision was naturally essential, it was not in itself enough. The primary requirement was men of the right training and outlook. If they were not available, the money which was allocated for research would largely be wasted.

A.C. Vector Notation (*Concluded from previous page*)

The neutral current I_O is the resultant of the three phase currents and equals $(I_A + I_B + I_O) = V(\cdot 4 + \cdot 183 + \cdot 09 - j\cdot 2 - j\cdot 683 + j\cdot 34) = V(\cdot 673 - j\cdot 543)$. Its magnitude is $\sqrt{\cdot 673^2 + \cdot 543^2}$ and its angle to the reference voltage is arc tan $\frac{\cdot 543}{\cdot 673} = 39$ deg. lagging.

PERSONAL and SOCIAL

News of Men and Women of the Industry

At a meeting of the Cardiff City Council last week a proposal to increase the salary of the city electrical engineer (Mr. **E. Jones**) from £1,400 to £1,750 and to reduce his fees for special services from £500 to £150 was adopted. Against the proposal it was urged that this was an attempt to transfer a portion of the fees now met by the Central Electricity Board to the ratepayers. While it would make no difference to Mr. Jones's remuneration, an additional sum would be assessable to superannuation. Alderman A. E. Gough said that if Cardiff paid on the National Joint Committee scale Mr. Jones would be receiving something like £2,000.

Mr. E. W. Connon's appointment as chief technical assistant in the Sheffield Corporation Electricity Department was confirmed by the City Council at its meeting on December 1st. Mr. Connon received his engineering education at the Universities of Aberdeen and Liverpool and afterwards served his apprenticeship with the English Electric Co., Ltd., Stafford, and remained with the company as research engineer, later becoming engineer-in-charge of the research laboratory. In 1936 he was appointed electrical testing engineer to the North West Midlands Joint Electricity Authority, being promoted to the position of technical assistant in 1941. He holds the degree of B.Sc. in Engineering of the University of Aberdeen and M.Eng. of the University of Liverpool, and is an associate member of the Institution of Electrical Engineers.

Mr. E. W. Connon

Alderman Dudley Stuart, M.I.E.E., has been re-elected chairman of the London and Home Counties Joint Electricity Authority for the ensuing three years and **Alderman W. H. Shaw** has been re-elected vice-chairman.

Mr. A. J. Shrosbery has been elected a director of T. Clarke & Co., Ltd. After technical training, Mr. Shrosbery served with Johnson & Phillips, Ltd., British Insulated & Helsby Cables, Ltd., and the Macintosh Cable Co., Ltd., and then became mains engineer at Nuneaton. He occupied similar positions at Norwich and Pooley Hall before joining T. Clarke & Co., with whom, for the past four years, he has been in charge of Air Ministry distribution contracts. Mr. Shrosbery is joint patentee of devices for handling and feeding cables and ducts laid by plough.

Mr. E. G. Sellers, sales manager of Elexcel, Ltd., has been appointed a director of the company. Mr. Sellers began his career in the electrical industry with the British Westinghouse & Electrical Co., Ltd., London, and later became district manager for Metro-Vick Supplies, Ltd., Sheffield. Upon this company's merging with the Edison Swan Electric Co., Ltd., he was appointed manager of the Leeds branch of the joint companies. He joined Elexcel, Ltd., in 1936 as district manager at its Leeds branch and was appointed sales manager in 1937.

Mr. E. G. Sellers

Severn Barrage.—Major Lloyd George announced this week that he had appointed **Messrs. A. G. Vaughan Lee, S. B. Donkin** and **W. T. Halcrow** to review the recommendations of the Severn Barrage Committee in the light of present conditions.

Mr. S. T. Gamlin, who has been appointed telephone manager for the York district, commenced his career with the National Telephone Co. in 1907.

Mr. Philip Schloss, who has been a director of Tube Investments, Ltd., for twenty-one years, has resigned owing to ill-health.

Mr. H. Pilling, A.M.I.E.E., transport manager and engineer at Accrington since 1911, is resigning for health reasons, states *Modern Transport*.

H.R.H. the Duchess of Kent recently paid a visit to the Britannic Electric Cable & Construction Co.'s works at Iver. With her in the photograph are, from left to right, Viscount Elibank (chairman of the company), Mr. A. Stanley McHugh (managing director), Mr. C. D. Short (Ministry of Labour) and Sir Arnold B. Gridley (vice-chairman)

Mr. E. J. Calf, senior control room operator at Fulham power station, has been recommended by the Staff Committee of the Council for appointment as charge engineer to fill the vacancy caused by the retirement of **Mr. J. A. Eden.** The Committee also reports the resignation of **Mr. A. C. Willgress,** assistant control engineer, who has obtained an appointment with the London Power Co. **Mr. H. C. Newman** is recommended for promotion to the position of chief clerk in the Electricity Department in succession to **Mr. T. H. Taylor,** who has retired.

Mr. H. R. Beasant, chief electrical engineer to the Bristol Tramways & Carriage Co., Ltd., has been appointed as branch manager and technical representative to the Enfield Cable Works, Ltd., in charge of the South-Western branch, covering the South West of England and South Wales, with offices at 4, Colston Street, Bristol, and 108, Commercial Street, Newport, Mon. Mr. Beasant received practical training with the Bristol Tramways and technical education at the Merchant Venturers' Technical College, Bristol. He became assistant engineer to the Bristol Tramways in 1907; distribution, overhead lines, and installations engineer in 1912; assistant electrical engineer in 1917; and chief electrical engineer in 1928. He was chairman of the Western Centre of the I.E.E. in 1940-41, having been assistant hon. secretary from 1926 to 1930 and hon. secretary from 1930 to 1938; and he is a past president of the Bristol Association of Engineers, past chairman of the Bristol Electric Club and member of the Public Transport Association Inc., formerly the Tramways, Light Railways & Transport Association, whom he represents on the Joint Committee of Electrolysis of Underground Cables. He was also formerly a member of the Joint Overhead Equipment Committee. On December 9th Mr. Beasant returned to the offices of Bristol Tramways & Carriage Co. to receive from Major F.J. Chapple, D.S.O., general manager, on behalf of his former colleagues, a wallet and cheque with a testimonial signed by the subscribers representing all branches of the company's activities.

Mr. H. R. Beasant

I.E.E. Students' Dance.—A dance held at Lysbeth Hall, Soho, on December 11th, by the London Students' Section of the I.E.E. was highly successful. Over 150 members and friends, including the President, Col. Sir Stanley Angwin, and Lady Angwin, Mr., Mrs. and Miss W. K. Brasher, Dr. and Mrs. P. Dunsheath, Mr. and Mrs. A. J. Gill, Mr. J. H. Reyner and Mr. F. Jervis Smith, were present. The Section's next dance will be held on March 18th.

Mr. W. Docwra, rolling stock engineer in the passenger section of the Brighton Corporation Transport Department, has been in addition appointed rolling stock engineer in the commercial section, following the death of Mr. G. Tappenden in August last. Mr. Docwra has been with the undertaking for fourteen years, having previously been technical assistant and deputy rolling stock engineer.

Obituary

Mr. K. Preston.—The death occurred on December 1st of Mr. Knowles Preston, late chief chemist of Pritchett & Gold and E.P.S. Co., Ltd. Mr. Preston, who was a leading figure in the technical and research branches of the accumulator industry, joined Pritchett & Gold, Ltd. (as the firm then was) in 1908 and remained as chief chemist until his retirement in 1940, during which period he was responsible for many improvements in the manufacture and performance of the lead-acid accumulator.

Mr. N. O. Curry.—We learn from the South *African Engineer and Electrical Review* of the death at Umkomaas of Mr. Norman Oswald Curry, who was for a number of years chairman of the African Overseas Committee of the British Electrical and Allied Manufacturers' Association. He served his apprenticeship with the Tyne Steam Shipping Co., Ltd., and in 1901 joined C. A. Parsons & Co., Ltd., at Heaton. Three years later he was transferred to Leeds, where he superintended the erection of the company's plant and in 1906 he was appointed joint works manager. In 1912 he was sent to superintend the erection of plant in South Africa and in 1914 he became the company's representative there with headquarters at Johannesburg. He held this position and also represented A. Reyrolle & Co., Ltd., at the time of his retirement in 1938.

Mr. J. Scott.—The death occurred at Birmingham last week of Mr. John Scott, O.B.E., at the age of seventy-six. Mr. Scott joined the National Telephone Co. in 1895 and was successively district manager at Galashiels, Blackburn, Leeds and Manchester. He was appointed assistant provincial superintendent at Birmingham in 1908 and later, after being transferred to the Post Office service, became postmaster at Sheffield and eventually postmaster-surveyor at Birmingham.

Mr. Hubert W. Corby, a former Controller of International Communications, Cable & Wireless, Ltd., died recently at Reading. Mr. Corby was well known in the communications world through his long association with Marconi's Wireless Telegraph Co., Ltd., as assistant secretary and later secretary.

Mr. T. P. Sykes.—The death occurred on Sunday last of Mr. T. P. Sykes, manager since 1919 of the Rotherham Corporation Transport Department, at the age of 62. Mr. Sykes, who was formerly engineer to the Bradford Corporation Transport Department, was a member of the Joint Industrial Council for the Transport Industry, and ten years ago was appointed inspecting engineer of material purchases in England for the Cape Electric Tramways Co.

Baron Grævenitz.—We learn with regret of the death on December 8th of Baron Peter Grævenitz, who had been a director of Siemens-Schuckert (Gt. Britain), Ltd., since 1935. Baron Grævenitz was a Russian by birth and held the rank of lieutenant-colonel in the Russian Imperial Army. On his mother's side he was a member of the Siemens family. After the last war Baron Grævenitz settled in this country and became a British subject. He was actively interested in the work of the Electrical Industries Benevolent Association, of which he was a governor.

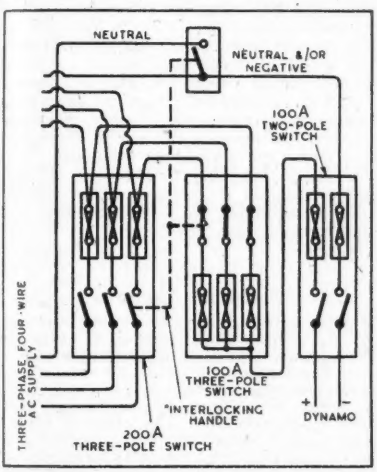
CORRESPONDENCE

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for correspondents' opinions.

An Emergency Supply

I AM foreman electrician to a firm which employs about 700 men, at least half of whom are transported to work a distance of ten or twelve miles. A failure of the electricity supply would have serious consequences as all the work is carried on in buildings that are permanently blacked out, and I therefore evolved the following scheme which cost approximately £115 and maintains all essential services.

Normally a three-phase four-wire 400-230-V service supplies light, heat and power. The small single-phase portable apparatus, including drills, screwdrivers, sanders, hand-lamps and all fixed lighting, with an installed capacity of 30 kW, is essential. The three-phase machinery is not so important. We



had a 40-HP petrol-paraffin Crossley engine fifteen years old lying idle, and as the portable tools had universal motors and the lighting was by gasfilled filament lamps I purchased an old 250-V DC dynamo, which was driven from the engine by a belt.

A fifth wire, the dynamo positive, was run to the main switch, the neutral acting as negative. A double-pole switch with fuses has been interposed between the dynamo and the 200-A three-pole main switch, which is interlocked with a 100-A three-pole switch placed upside down beside it. The three poles of the latter are linked together and joined to the dynamo positive. From the outgoing side of the AC main switch three wires are connected to the 100-A switch. Opening the 200-A main switch closes the 100-A triple-pole switch, bunching the three phases together at the dynamo positive, and disconnects the AC neutral, although leaving a continuous neutral or negative throughout the installation.

The dynamo negative is earthed, so that when supply is given by the emergency plant the earth-leakage trips installed at every plug socket will still function. It takes about ten minutes to get the emergency supply going.

As the mains have failed through enemy action and other causes seven times (but never longer than one day at a time) since the scheme was introduced, it has paid for itself several times over.

Cornwall. E. WILLIAMS.

Electricity Supply Administration

FROM the reactions of the members at the recent I.E.E. discussion on "The Administrative Structure of Electricity Undertakings," it would seem that among the "under 40's," at least, there is a growing appreciation of the importance of administrative training in the make-up of the engineer. Impressions were also that the older members still in the main treat the supply industry as a feat of engineering and have little time for the administrative officer.

No way of combating the growing tendency to appoint separate "engineers" and "managers" to undertakings was suggested beyond commenting that it was not in the interests of the industry. If this tendency is allowed to grow, the fault can only be placed at the feet of the engineers themselves. Few engineers have tried to study the electrical side without realising that mechanical engineering must receive a quota of attention; should not the legal, accountancy and commercial fields also be covered?

The alternative to a qualified administrative engineer is (*a*) to appoint as assistant to the engineer an administrative officer who is not qualified to do more than attend to the more pressing problems of organisation; or (*b*) to engage an expert administrative officer who, due to better organising ability, may eventually take over the reins of office.

In this search for the broad outlook the qualifications given by the examination and membership of the Chartered Institute of Secretaries can be recommended. The choice of subjects offered can guarantee a

member not only an intimate knowledge of electricity law, but also the ability to juggle with the net revenue and appropriation accounts, which is very often apparently despised—and secretly envied. A further avenue is the Institute of Industrial Administration whose membership to-day is increasing in the supply industry. The value of such institutions cannot be measured by membership. What is interesting, however, is the proportion of members admitted due to the position they hold, compared with those who have proved their knowledge (ability must be shown in another field) by examinations. If such figures are available for the various institutions which purport to cater for this class, publication would no doubt be of interest to many.

Great Yarmouth. ROYDEN C. GOLDING.
Deputy Borough Electrical Engineer.

"What Was Right?"

IT was interesting to read the report from the *New Zealand Electrical Journal* in your issue of December 10th. From this it would appear that the electricity authorities in New Zealand take a live interest in electrical installations. Very many installations in this country are on a par with those described in the report but no one here is even censured for carrying out such atrocious work.

Only a comparative handful of reputable consultants and contractors in this country are concerned about safe and satisfactory electrical installations. I have written many letters to the *Electrical Review* on this subject and I hope before I "shuffle off" that something will eventually be done to make electrical contracting a profession instead of a disease.

Glasgow. ALEX. MILNE.

Synchronous Turbine Governing

YOU point out in the editorial comment in your issue of December 3rd that no such scheme as that of Professor Prescott has yet been applied to large generating plant. It may, however, be stated that several systems of automatic frequency control employing a modified form of synchronous governing have been developed both in England and abroad; the information given by Professor Prescott is thus likely to be most useful to designers of the automatic gear used.

In a scheme with which I am associated, and which was first applied in a power station some years ago to a 1,500-kW turbo-alternator, the governing has the main characteristics of the scheme described by Professor Prescott, although the result is obtained in a different way, and by purely electrical means. The normal centrifugal governor is retained, but is placed under the continuous control of a "frequency controller," in which impulses, at 2-sec. intervals, from a master clock are used to vary the setting of the governor in dependence on the number of revolutions made by the turbine. Hunting is avoided by the introduction of the equivalent of a damping term, as in Professor Prescott's equation (2); for this purpose, a moving part in the controller ensures that the correcting impulses decrease as the correct frequency is approached after having been disturbed by a change in load. The position of this part gives a visual measure of the permanent change ("integrated frequency error") in angular displacement of the turbine shaft.

While it may at times be useful, as suggested, to eliminate the integrated frequency error, its presence is usually desirable. In the usual power system, the sharing of load between alternators in parallel depends upon the drooping characteristics of the turbine governors. With automatic frequency control, the governor characteristic is in effect changed to a horizontal line, but an alternative basis for load sharing is to hand, in the integrated frequency error. In other words, the sets share load on the basis of total number of revolutions rather than speed of revolution. Such a system has been found also to facilitate the control of load in a system fed by several generating stations, while having the further advantage of giving an accurate control of the speed of motors; the integrated frequency error is so small that the timekeeping of synchronous clocks is greatly superior to that generally obtained on systems under the usual manual frequency control.

Witton. J. W. GIBSON.

Christmas Lectures

THIS year's Christmas Lectures at the Royal Institution, "adapted to a juvenile auditory," are to be delivered by Professor E. N. da C. Andrade, D.Sc., F.R.S., Quain Professor of Physics in the University of London. His subject is "Vibrations and Waves," illustrated by experiments. The heads of the six lectures are:—Vibrations; wave properties in general; sound waves; visible light; short electromagnetic waves; and long electromagnetic waves. The lectures will be given on December, 28th and 30th, and January 1st, 4th, 6th and 8th at 2.30 p.m. The subscription for the course is 10s. 6d. for juveniles, aged 10-17 and 21s. for adult non-members. Tickets are obtainable from the Royal Institution, 21, Albemarle Street, W.1.

Indian Hydro-Electric Project. — It is reported in *Indian Engineering* that preliminary investigations and surveys are being carried out in connection with a proposed hydro-electric scheme on the border of Madras and Orissa. The development, which is likely to cost Rs2,52,00,000, will supply power to both provinces. It is expected that work on it will be started after the war.

Relay-setting Slide Rule

Simple Device for Reducing Errors

By T. D. Oswald, B.Sc.

THE characteristics of an inverse time-limit relay are usually presented as a set of curves indicating the ratio of fault current to tripping current plotted against the time to trip. The tripping current is usually selected by means of a plug device calibrated as a percentage of the rated primary current of the current transformer. The characteristic curve upon which the relay is to operate is then selected by means of a time-setting disc.

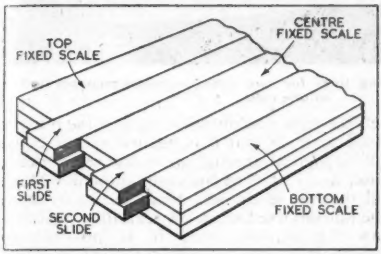


Fig. 1.—Fixed and moving component parts of cardboard rule

To obtain correct discrimination between a number of these relays under a variety of fault conditions involves a considerable amount of slide-rule work and repeated reference to the set of curves. The risk of exasperating errors can be reduced and the comparison of various settings rendered simple and obvious by the use of an easily constructed slide rule.

The rule consists of three fixed scales and two slides. The top fixed scale and the upper edge of the first slide enable the ratio of fault current to tripping current to be set on the rule. This ratio positions an arrow-head on the lower edge of the first slide against a nest of lines drawn on the centre fixed scale. This nest is the feature of the rule, whereby the characteristic curve of the relay is represented on it. An arrow-head marked on the upper edge of the second moving slide is positioned against the lower edge of the nest of lines so as to correspond to the arrow-head of the first slide.

This lining up of the arrow-heads at opposite sides of the nest positions the lower edge of the second slide, graduated with the markings of the relay timing disc, against the bottom fixed scale which is graduated with the time required by the relay to trip. The operating time can then be read off against any desired timing disc setting, and the operating times of a whole series of relays compared at once.

The rule now in use is about 16 in. long and is constructed of cardboard (Fig. 1). The various slides and fixed parts are clipped together by means of an office stapler. This simple mechanical construction of the rule can be completed in half an hour. The top fixed scale is graduated from 100 to 20,000 A, fault current, from left to right, and is marked off from the graduations on the upper edge of the slide of an ordinary 10 in. slide rule. The upper edge of the front sliding scale is graduated from 50 to 1,000 A tripping current in the same way. The upper edge of the bottom fixed scale is graduated from 0·1 to 20 seconds, time to trip. The 10 in. rule slide is in this case used upside down so that the time increases from right to left.

To construct the nest of directing lines on the centre fixed scale, set the first sliding scale at the highest ratio of fault to tripping currents required, usually about 20 to 1. Mark an arrow head on the lower edge of the first slide to face a convenient point on the upper edge of the centre fixed scale, just inside the edge of the rule, and mark this point. Reset the first slide to a ratio of 19 to 1 and mark the point on the centre fixed scale now opposite the arrow head. Repeat this process down to the lowest ratio that is required, usually about 1·5 to 1.

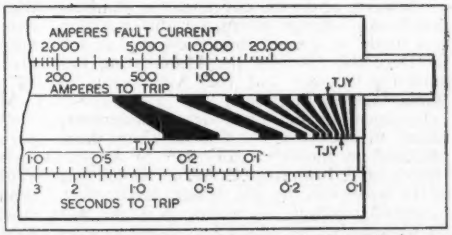


Fig. 2.—Slide rule set for ten-to-one fault-to-tripping currents

Referring to the relay manufacturers' set of characteristic curves and taking any one (say the topmost) as a basis, read off and tabulate the tripping time corresponding to each of the ratios used in marking off the upper edge of the centre fixed scale. Starting from a point directly beneath the outside

mark on the upper edge, mark the lower edge with graduations corresponding to the tripping times just tabulated, in ascending values from right to left, using the 10 in. rule slide upside down for this purpose. Connect up corresponding graduations on the upper and lower edges of the centre scale. The nest is made more distinctive by blacking in alternate spaces. The upper edge of the second moving slide is marked with an arrow head near to the right-hand end.

Reference to the relay makers' set of characteristic curves will show that a particular ratio of fault tripping current, usually 10 to 1, has been used as a basis for marking the timing disc. Read off the tripping time of this ratio for the topmost of the characteristic curves, *i.e.* that for the maximum timing disc setting. Set the first slide to this ratio and position the arrow head on the second slide against the nest of directing lines at a point corresponding to the position of the arrow head on the first slide.

The lower edge of the second slide now lies against the graduations on the bottom fixed scale in a position corresponding to the selected ratio of fault to tripping currents. The rule illustrated (Fig. 2) with nest of directing lines for a Reyrolle TJY relay is shown set in this position. Locate the tripping time, read off above, on the bottom fixed scale and mark the lower edge of the second slide at this point. This represents the maximum disc setting. The relay timing disc is usually graduated 0·3 to 3 or 0·1 to 1. In any case, move the second slide so as to set the mark just obtained against the bottom fixed scale so that it is against a time equal to the highest graduation on the relay timing disc, *i.e.* 3 or 1 in the cases quoted. Mark off the rest of the second slide directly from the bottom fixed scale. By carefully positioning the arrows, etc., it is possible to incorporate nests of directing lines for two different relays on the same rule as shown in Fig. 3.

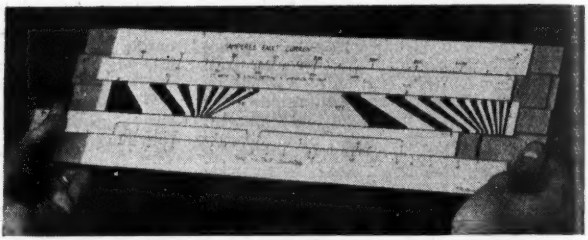


Fig. 3.—Nests of directing lines for two different relays incorporated on one rule

Once attempted, this method of marking off the rule will be obvious, and a neat, accurate job can be made.

Public Lighting Specifications

SHOULD street lighting specifications of the future be based on the design of the lantern, or on the effect of the illumination? An attempt to answer this question was made at a joint discussion in London on December 14th of the Illuminating Engineering Society and the Association of Public Lighting Engineers.

In opening the case for measurements made on the road as distinct from those obtained in the laboratory Dr. S. English (Holophane, Ltd.) argued that as the lighting of the street was the aim of the specification, it should naturally be based on it and not on something that might be related to it in some partially understood way.

Three arguments against such a direct method of specifying what was required were discussed and shown to be ill-founded. These arguments were : because it had been tried and failed ; street lighting was so complex a problem that it could not be specified directly ; and A.R.P. street lighting specifications were based on lantern performance and had been found satisfactory.

Although it was not an essential part of the argument in favour of measurements on the roadway, suggestions were made of the lines on which a specification based on such measurements might be framed, care being taken to avoid the defects found in B.S.S. 307/1931.

Mr. R. Maxted (B.T.H. Co.) contended that it was not practicable to specify the performance of a street lighting installation, owing, on the one hand, to the impracticability of measuring visibility, and on the other to the extreme diversity of relevant street characteristics. Nevertheless, experience showed that it was a practical engineering proposition to design an installation with reasonable certainty of providing a satisfactory performance. This was certainly true if the lighting engineer was also able to specify the nature of essential background surfaces.

Visibility could be ensured at an economic cost by a code of street lighting practice, and a correlated British Standard Specification dealing with street lantern performance.

COMMERCE and INDUSTRY

Salvage and Benevolence.

Success of Paper Salvage Campaign

THE Electrical Industries Benevolent Association has already benefited to the extent of over £500 from the proceeds of waste paper sales which have been allocated to its funds as a result of the drive by the Electrical Industry Waste Paper Recovery Committee. The largest single contributor to this total is W. T. Henley's Telegraph Works Co., Ltd., whose "spring clean" realised £160. The next largest contributor is Foster Transformers & Switchgear, Ltd., which has produced over £80. The E.I.B.A. is naturally keen to know whether there is any other company which can rival these achievements.

Limitation of Supplies

The Board of Trade has issued an Order (S.R. & O. 1943 No. 1637; Stationery Office, price 1d.) requiring every person whose name was entered in the Home Trade Register at July 31st, 1943, to make a return on Form Misc./17, showing, *inter alia*, the value of controlled goods supplied by him during the standard period (June 1st, 1939, to May 31st, 1940) and during the restriction period (February 1st, to July 31st, 1943). A copy of the appropriate form has been sent to each person concerned, but any trader who has not received his copy should apply for one to the Chief Accountant, Board of Trade, (Miscellaneous Section), North Gate, Prince Albert Road, London, N.W.8.

Reduction of Minimum Charges

As reported in our last issue, the Minister of Fuel and Power has announced his intention of issuing an Order to amend the Electricity Minimum Charges Order and General Direction, 1942. The effect of the amending Order (which will come into force on a date to be announced later) will be to provide that the minimum charge for flat-rate consumers shall not exceed 10s. per annum, instead of 25s. as at present.

In correspondence with the electricity supply associations, it has been suggested that the amending Order should apply only to domestic consumers, but the Minister feels that it is impracticable to distinguish between different types of consumer. On a second point raised regarding the re-imposition of meter rents where they are not at present being charged, the Minister has informed the Electricity Commissioners that he desires that undertakings should first submit their proposals to the Commissioners with the necessary supporting data in order that he may have an opportunity of considering the position.

It is stated that the reduction to 10s. is being made because there is ample evidence to show that the 25s. per annum fixed in the Order of September, 1942, is acting as a deterrent to fuel economy. Representations have been made to the Minister that it is desirable to abolish minimum charges altogether but he has not found it possible to accept this view.

Minimum Charges Order.

Every consumer, however small, involves the supply undertaking in expenditure and it is not unreasonable that each should contribute some minimum revenue towards these costs and expenses. Furthermore, it must be remembered that apart from domestic consumers practising fuel economy, there are many who have small bills because it is convenient for them to have electricity installed and use it as and when they wish. For instance, there are houses which are infrequently used by persons who have moved into the country; small offices; lights on stairs of tenements, etc.

More Radio Sets

The radio industry has been authorised to complete receivers which were left partly finished when the manufacturers changed over to the production of radiolocation equipment and other war requirements. On September 30th, 75,000 civilian sets still required completion, and these will be made available as soon as possible. In view of the inadequacy of this quantity to meet present demands arrangements have been made to import a substantial number of sets from America, and about 10,000 have already arrived in this country. It is anticipated that the majority of these sets and also the 75,000 British sets will be on the market early in 1944.

For 1944 arrangements are well advanced for the production of wartime receivers in this country. They will be made to a standard design by various manufacturers, but will not be sold under the trade names of their makers. Distribution will be through normal trade channels, with preference to those areas most urgently in need of sets, but substantial quantities are not likely to be available before June. The prices of these wartime sets and of the imported sets will be covered by Maximum Price Orders.

New Zealand Electrical Imports

The latest available statistics of New Zealand's import trade refer to the six months ended June last. Electrical items mentioned are as follows, with a note of increase or decrease compared with the first half of 1942:—Electrical machinery and equipment, £(N.Z.)1,215,000 (+ £379,000); wireless apparatus, £193,000 (+ £98,000); meters, etc., £118,000 (+ £39,000). There was thus a substantial increase (£516,000) over the corresponding period of last year.

Figures published in the *New Zealand Electrical Journal* show that during the second quarter of this year the value of electrical (excluding radio) apparatus imported was £(N.Z.)836,942, which compares with £479,084 in March-June, 1942. The principal item was cable and wire, £407,568, mostly from the United Kingdom (£337,969); other suppliers were United States, £51,617; Canada, £10,377; Australia, £7,605. Electric motors were imported to the value of £67,371 (United Kingdom, £42,409; Canada, £14,973; United States, £9,457; and Australia, £532). Of electric lamps imported to the value of £22,747 the

United Kingdom's share was £12,245, followed by the United States (£6,420) and Canada (£4,082). All wireless sets (value £1,072) came from the United States, who also supplied the bulk of the valves for receiving sets (£66,850 out of £68,342; United Kingdom £1,111; Canada £381). Of other radio apparatus imported (£60,082) the share of the United States was £33,294; United Kingdom, £14,269; Canada, £11,863; and Australia, £656.

Inoculation Against Colds

To reduce the serious loss of production through absence from work of employees suffering from colds, influenza and their complications, Foster Transformers & Switchgear, Ltd., have given free preventive inoculation to any employees who wished for it. Special arrangements were made with the company's medical officer to carry out the treatment during working hours, and to avoid interference with the work of the company's permanent surgery and personnel the staff canteen was temporarily adapted for the purpose. An additional trained nurse was engaged to assist the doctor and a team selected from the personnel department staff also helped. One assistant took details of name, etc., a second rolled up sleeves and several hypodermic syringes were kept sterilised by another assistant and were prepared for the doctor by the nurse. Finally, a small antiseptic dressing was applied and the employee returned to work. In this way it was found that between 150 and 200 injections an hour were possible. The complete treatment requires three inoculations at intervals, and records are being kept of each individual treated.

Australian Lighting Regulations Invalid

A High Court judgment in Australia has ruled that the National Security Regulations governing industrial lighting are invalid. The *Merchandiser* (Sydney) reports that the judgment arose out of an application by the Victorian Chamber of Manufacturers and others for an injunction restraining the Minister of Labour and Social service from enforcing regulations requiring the installation of extensive lighting equipment in industrial premises. It was contended that compliance with the order would involve the manufacturers in heavy expenses and that there would be great difficulty in obtaining the necessary skilled labour. The Chief Justice declared that the regulations had no real connection with defence, and that the existence of a state of war did not justify the handing over to the Commonwealth of general control of industrial standards.

Consumer Fined

An unusual case was dealt with at Derby Police Court recently when an electricity consumer was summoned for "having hindered" a Corporation official. It was stated that Mr. G. E. Pegg, an inspector of the Electricity Department, was sent to defendant's house to disconnect the meter because an outstanding account had not been paid, but he was refused admission. A letter was sent stating that the inspector would call on October 5th. On that date Mr. Pegg knocked at the door at intervals for half an hour but nobody answered, although as he was leaving he saw a woman inside the house. The account had since been paid, but it was felt that defendant should be made to understand that inspectors had plenty to do without making fruitless journeys to a house. Defendant, who did not appear or write, was fined £2.

Unreported Accidents

At Nottingham Summons Court, John Jardine, Ltd., Chelsea Street, New Basford, were fined £5 on two charges of not reporting accidents and £10 for not having portable electrical apparatus efficiently earthed.

A factory inspector stated that a boy named Bannister, who was an electrician's assistant, was testing electric wires with a lamp on June 30th when there was a flash and he was injured. On September 13th he was using an electric drill which became alive and he received a shock.

For defendants it was stated that the accidents had been entered in a book and the boy received compensation. For years the supply had been at 100 V, but 14 days before the first accident it was changed to 230 V. The company was unaware that it was necessary to earth portable apparatus after the change.

Fatality in Bathroom

An inquest was held at Gillingham recently on Mrs. Caroline Lilian Hopkins (52), a widow, who was found dead in her bathroom. A doctor, who stated that death was due to electric shock, said there had been an electric heater hanging suspended by its flex from a lampholder in the wall, and deceased had burns on her nose, chin, right hand and left armpit.

Mr. H. Hall, borough electrical engineer of Gillingham, said that he had tested the heater and found it quite in order, but the flex lead at the back was not in place and the insulation at the point of entry was damaged. If the exposed wires came in contact with the frame it would give a considerable shock.

The coroner, recording a verdict of "Death by misadventure," said it seemed quite clear that deceased, who was subject to fits of giddiness, must have come over faint and, feeling herself falling, grasped the nearest object—the heater. The strain must have bared the wires.

Colombian Trade Opportunities

The *Foreign Commerce Weekly*, issued by the U.S. Department of Commerce, contains some notes on the present and prospective market for motors and other electrical goods in Colombia. In normal times there is a general demand for polyphase motors, single speed of 1,200 or 1,800 RPM, complete with flat-belt pulleys and adjustable base, 1, 2 and 5 HP being the leading sellers. Fairly low horse-power squirrel-cage motors are considered stock items, including manual or magnetic full-voltage starting equipment with overload protective devices. It is said that slip-ring motors are too expensive and usually are sold only on special order. Stock items also are small single-phase (fractional horse-power) 115/230-V, split-phase, repulsion induction or capacitor types, while ½ to 2-HP motors of the same type also are popular. Little demand is seen for DC motors.

According to this Washington report, the

textile industry offers one of the most important motor markets in Colombia. Squirrel-cage ½- and ¾-HP constant-speed three-phase motors with V-belt pulleys are used for driving looms, of which about 8,500 are in operation in the country. From reliable sources it is reported that the textile industry is planning to expand, and that about $5,000,000 worth of electrically driven textile machinery will be needed after the war.

For use in the mining of alluvial deposits it is expected that after the war there will be a material increase in the demand for standard motors with a 40 deg. C. rating, 200 to 300 HP, 1,800 RPM, wound rotor with adjustable speed and directly connected to centrifugal pumps.

There is a limited market for motor-generator sets for use by garages and plating concerns, and a fair market for petrol-driven generators.

Factory Heating and Lighting

The first of a series of pamphlets issued by the Industrial Health Research Board of the Medical Research Council (Stationery Office 3d.) deals with ventilation, heating and lighting. In this it is stated that the fresh-air supply in winter should not be less than 1,000 cub. ft. of air per hour for each person with a minimum average air speed of 20 ft. per min.; these figures should be greatly exceeded in summer. The close connection between temperature and output is illustrated by a graph relating to tinplate workers which shows a reduction of output by 10 per cent. in the hottest months. Another graph shows that accident frequency is least with shop temperatures between 65 and 70 deg. F. Lighting and seeing are discussed from the hygienic and output aspects. A bibliography of official publications on these subjects is included.

Executive Staffs

The first annual general meeting of the Executive Staffs Branch of the Association of Supervisory Staffs and Engineering Technicians was held in London on December 6th. Satisfactory progress was reported. Inquiries regarding activities of this Branch should be addressed to the secretary, Executive Staffs Branch, 13, Balham Park Road, S.W.12.

Training Young People

Leicester City Education Department has published a 24-page preliminary report which is intended to serve as a basis for discussion with educationists and industrialists in Leicester on the function and curriculum of the Young People's Colleges proposed in forthcoming legislation. The report has been prepared as a result of discussions with the principals and representatives of industry and commerce.

Power for the Highlands

An explanation of the aims and objects of the proposed Scottish Hydro-Electric Scheme is given in a film entitled "Power for the Highlands" which the Ministry of Information has produced as one of a series to be made for the Scottish Office. Various reactions of the people of the Highlands are shown, with the younger members quickly seeing the possibilities of the scheme, but an old gamekeeper being persuaded to see good in it only after two American soldiers have told him of the benefits of the Tennessee Valley Authority. The film is being released next Monday.

"Rebuilding Britain"

The exhibition "Rebuilding Britain" organised by the Royal Institute of British Architects which was held in the National Gallery, London, earlier this year is being repeated on a smaller scale in the Scottish Building Centre, 425, Sauchiehall Street, Glasgow, C.2, from December 16th to 30th. The subject of the exhibition, as the name implies, is the replanning of Great Britain and the rebuilding of its cities. It gives a lead, indicates some of the problems to be solved and offers some solutions for consideration.

Protecting Fire Pumps

Coventry Climax Engines, Ltd., Mount Sion, Oswestry, Shropshire, have sent us an instructional chart showing how their "Climax" trailer fire pump can be protected from the effects of frost. The chart is supplied gratis to N.F.S. and private fire brigade officers; to others the charge is 6d.

E.A.W. Request Refused

Warrington Corporation Electricity Committee has refused an application from the local branch of the Electrical Association for Women for the co-option of a member of that Association on the Electricity Committee.

Works Supply Scheme

In the article under the above heading in the *Electrical Review* of November 12th, the breaking capacity of the 6·3 kV switchgear was stated to be 25 MVA. This should have read 250 MVA.

Trade Announcements

Brook Motors, Ltd., have moved their London service and sales office to Kingsbourne House, 229-231, High Holborn, London, W.C.1 (telegrams: "Brookmot, Phone;" telephone: Holborn 0219 and 0210).

Change of Name

With regard to the note under this heading in our last issue, it is pointed out that it was the S.D. & S. (not S.D. & T.) Electrical Ltd., which has changed its name to Sid Dagnall & Son, Ltd.

INFORMATION DEPARTMENT

GENERAL inquiries from readers relating to sources of electrical goods, makers' addresses, etc., are replied to by our Information Department through the post. Inquiries should be accompanied by a stamped addressed envelope.

Our extensive records enable us to reply to most queries, but occasionally we ask for our readers' assistance in tracing names and addresses not known to us. We should be glad to have such information regarding the following:—

Address of Chandos Engineering Co.

ELECTRICITY SUPPLY

Chichester Concession. Hastings Installation Work.

Aberdeen.—TRIAL LIGHTING.—The Council has agreed to an experiment being made with "starlighting" in main streets.

Accrington. — MARKET LIGHTING. — The borough electrical engineer has submitted a scheme for the thorough overhaul of the outside lighting of a portion of the town market and for the complete rewiring of the remainder. He recommends that there shall be three 100-W lamps per standard stall and that there shall be a periodical examination of the installations. The Markets Committee has approved the scheme in principle, with the proviso that wherever possible the wiring shall be laid underground.

INSPECTION OF INSTALLATIONS.—A proposal by the electrical engineer to inspect all electrical installations under the control of the Transport Committee with a view to bringing them up to a proper standard has been adopted.

Barking.—REVISION OF TARIFFS.—Under a new scale of electricity charges which comes into operation at the beginning of next year the addition of 20 per cent. where at present applied is reduced to 12½ per cent. (except prepayment domestic rate). The 5 per cent. discount for payment within one month is, however, discontinued. A change is made in the prepayment flat rate for lighting, which instead of 4¾d. per kWh becomes 3d. plus 15 per cent. (compared with the quarterly rate of 3d. plus 12½ per cent.). In the case of the prepayment domestic rate, the addition of 20 per cent. to the fixed charge is reduced to 15 per cent. and the "unit" charge is altered from ¾d. to ½d. plus 15 per cent.

Blackpool.—TRANSMISSION SYSTEM ALTERATIONS.—The Corporation Electricity Committee has obtained sanction to borrow £10,443 for its proportion of the cost of extending and modifying the e.h.v. transmission system.

Brighton.—PREPARING FOR PEACE.—Having considered a report by the borough electrical engineer, the Public Utilities Committee has instructed that all necessary steps shall be taken forthwith to enable the street lighting system to be put into commission throughout the town.

Cardiff.—COMMITTEE'S APPRECIATION.—The Electricity Committee has complimented the staff upon the high standard of efficiency and the excellent financial results achieved during the past year. It has arranged to invest £100,000 in Government securities.

Cheltenham.—SECOND-HAND COOKERS.—Sanction has been obtained by the Electricity Committee to spend £1,000 from surplus revenue on the purchase and reconditioning of second-hand cookers.

ELECTRICITY DEPARTMENT'S PROFIT.—A surplus of £7,343 for the year on the operating of the electricity undertaking is reported by the Electricity Committee.

Chichester.—MINIMUM CHARGE SUSPENDED.—To encourage full economy in the use of electricity the City Council on December 1st decided to suspend the minimum charge as from the next quarterly meter readings. In addition, we learn from Mr. H. E. Taunt, commercial manager, that it has always been a wartime policy of the Department to give consumers every reasonable facility for changing the basis of charge to a more beneficial tariff, or to modify demand charges, etc., where circumstances have compelled reductions in use.

Hastings.—CORPORATION INSTALLATIONS.—Complaint was made at a meeting of the Electricity Committee that on recent occasions certain Corporation departments had installed electricity for lighting and heating without inviting the Electricity Department to quote. It was agreed to recommend that Council committees should be asked to obtain quotations from the Electricity Department.

Mansfield.—MAINS AND SERVICES.—The Electricity Committee is seeking sanction to borrow £1,000 for mains and services.

Scarborough. — MODIFIED LIGHTING. — The Streets Committee has asked the borough engineer to make arrangements for a small number of lighting standards to be adapted for modified street lighting so that councillors can ascertain the value of such lighting before deciding on a general system of such lighting in the borough.

Sheffield.—SUPPLY TO STEELWORKS.—The Corporation has entered into an agreement to supply electricity to the English Steel Corporation.

Southport.—FARM SUPPLY.—The Electricity Committee is seeking a Fringe Order to provide a supply to Andersons Farm, Halsall.

Sunderland. — MODIFIED LIGHTING. — The Town Council has decided to introduce starlighting for the centre of the town. A suggestion that the system should be adopted throughout the town was rejected, the chairman of the Highways and Lighting Committees pointing out that this would cost £7,000 with £15,000 per annum maintenance charges. The lighting in the centre of the town, it was stated, would be controlled by a master switch.

Winchester.—SALE OF COOKERS.—The city electrical engineer (Mr. R. Ayton) has been authorised to sell electric cookers at their "written down" value to hirers who wish to purchase them.

York.—RURAL SUPPLY.—The Electricity Committee is seeking a Fringe Order for the supply of electricity to Ornhams Park Farm, near Boroughbridge.

TRANSPORT

Nottinghamshire and Derbyshire.—TROLLEY-BUSES.—The Nottinghamshire & Derbyshire Traction Co. is applying to Parliament for a Bill empowering it to run trolley vehicles on additional routes and for other purposes.

Sunderland.—DOUBLING TRAM TRACK.—The Transport Committee proposes to spend £7,000 on the laying of a double tram track in part of Durham Road in place of the existing single track. The cost will be borne out of revenue.

FINANCIAL SECTION

Company News. Stock Exchange Activities.

Reports and Dividends

Dictograph Telephones, Ltd., held their annual meeting on December 9th. Mr. John H. Whitfield, managing director, said that the results achieved could be regarded as satisfactory and revealed once again the ability of their business to withstand hard knocks. He considered that public telephone equipment should be conserved to the utmost for the use of the fighting services and civil defence organisations and that where an internal telephone installation was needed an independent private system should be installed. The company had adequate stocks of such equipment which could be put to good use now and recently there were signs that the Board of Trade was taking a broader view with regard to the granting of licences for them. The stability of the rental installation asset had been maintained in spite of restricted trading and another year of satisfactory trading could be reported on behalf of their subsidiary, Grampian Reproducers, Ltd., whose output was fully absorbed.

Tube Investments, Ltd.—The report for the year ended October 31st states that the increased demands made upon all factories have kept them extended to maximum capacity to meet the country's requirements. There was a net revenue, after providing for directors' fees £3,150 (£2,560), amounting to £685,152 (£612,559). The ordinary dividend is maintained at 20 per cent., £100,000 is again allocated to reserve, and a further £100,000 is added to reserve for war contingencies, leaving £251,641 (£171,065) to be carried forward.

S. Smith & Sons (Motor Accessories), Ltd., are paying a final dividend of 10½ per cent. on the preferred ordinary shares, making 17½ per cent. (same), and the dividend on the deferred shares is maintained at 37½ per cent. The net profit for the year ended July 31st amounted to £103,081, as compared with £103,439.

Scophony, Ltd., records a trading profit for the year ended March 31st last amounting to £14,900, as compared with £4,979. After providing for directors' fees, etc., a small loss incurred by Scophony Electromes and £1,000 for contingencies, there is a surplus of £10,921, which reduces the debit carried forward to £5,869 (£16,790).

John I. Thornycroft & Co., Ltd.—At the annual general meeting last week Sir John E. Thornycroft, governing director and chairman, said that there had been a further increase in the turnover of the business and they had carried out a considerable amount of pioneering work involving intensive research.

The London Electrical & General Trust, Ltd., is to pay an interim dividend of 2 per cent. (same).

E. K. Cole, Ltd., are to pay an increased dividend, 15 per cent., against 10 per cent. last year. A payment of a 3 per cent. participating dividend is also recommended on the preferred ordinary shares.

The Victoria Falls & Transvaal Power Co., Ltd., is maintaining its interim dividend at 4 per cent.

Mann, Egerton & Co., Ltd., report a net profit of £12,949 for the year ended September 30th last, against £14,854 for 1941-42. It is proposed to maintain the ordinary dividend at 10 per cent. and to transfer £2,500 (same) to general reserve, leaving £24,390 (against £24,134) to be carried forward.

Bullers, Ltd.—We reported last week that a dividend of 5 per cent. had been declared in respect of the past year. As an interim dividend of 2½ per cent. was paid last February, the total distribution for 1942-43 is actually 7½ per cent., as for the preceding year.

The Sun Electrical Co., Ltd., is to pay a first and final dividend of 2½ per cent. (same).

Sydney S. Bird & Sons, Ltd., are again paying a first and final dividend of 30 per cent.

The Engineering & Lighting Equipment Co., Ltd., proposes to pay an interim dividend of 4 per cent. (same).

The Electric Furnace Co., Ltd., is to maintain its interim dividend at 3½ per cent.

Ensign Lamps, Ltd., are to pay a final dividend of 5 per cent. as against 15 per cent., making 15 per cent. for the year (25 per cent.).

New Companies

Electrosonic, Ltd.—Private company. Registered December 4th. Capital, £500. Objects: To carry on the business of manufacturers of, and dealers in, wireless and television sets and accessories, lighting apparatus, electrical fittings, appliances and accessories, vacuum cleaners, etc. Directors: L. E. Tompkins, 97, Manor Avenue, S.E.4; R. G. Bishop, 34, Grasmere Road, N.10; C. C. Bishop, Homeleigh, Monks Road, Virginia Water, and H. G. S. West, 26, Huntingdon Road, Thorpe Bay, Essex. Registered office: 161, Wardour Street, W.1.

Relay Electric, Ltd.—Private company. Registered December 3rd. Capital, £1,000. Objects: To carry on the business of electrical, wireless, telegraphic, telephonic and motor engineers, etc. Directors: G. L. Clark, Shelford, Park Crescent, Erith, Kent, and C. G. Bartram, Alderley, The Mount, Fetcham, Leatherhead, Surrey. Registered office: 39, Victoria Street, S.W.1.

Tyler & Organ, Ltd.—Private company. Registered December 6th. Capital, £4,000. Objects: To acquire the business of an ironmonger and electrician carried on by R. W. Tyler at 95, High Street, Newport, Isle of Wight, and the similar business carried on by him at 22, Union Street, Ryde, as "R. & E. Organ." Directors: G. E. Tomlinson, 26, Upper St. James Street, Newport; and five others. Registered office: 21a, St. Thomas Square, Newport, I.W.

Company Struck off Register

The name of the following company was struck off the Register on December 10th, 1943, and is thereby dissolved:—Lighting Installations, Ltd.

Companies' Returns

Statements of Capital

Thorn Electrical Industries, Ltd.—Capital, £150,000 in 400,000 ordinary shares of 5s. each and 50,000 preference shares of £1 each. Return dated September 10th. All shares taken up. £63,150 paid. £86,850 considered as paid. Mortgages and charges: Nil.

Hewittic Electric Co., Ltd.—Capital, £50,000 in £1 shares (48,600 ordinary and 1,400 redeemable preference). Return dated September 3rd. 40,000 ordinary and 1,300 redeemable preference shares taken up, £40,000 paid. £1,300 considered as paid. Mortgages and charges: Nil.

Wholesale Electro (Halifax), Ltd.—Capital, £4,000 in £1 shares. Return dated July 22nd (filed August 21st). All shares taken up. £4,000 paid. Mortgages and charges: Nil.

Invincible Electrical Engineering Co., Ltd.—Capital, £1,000 in £1 shares. Return dated October 19th. 400 shares taken up. £400 paid. Mortgages and charges: Nil.

Birmingham Electric Furnaces, Ltd.—Capital, £1,000 in £1 shares. Return dated October 14th. All shares taken up. £1,000 paid. Mortgage and charges: Nil.

Increases of Capital

Morecambe Electrical Equipment Co., Ltd.—The nominal capital has been increased by the addition of £17,000 in £1 shares beyond the registered capital of £3,000.

Hipprum Wires, Ltd.—The nominal capital has been increased by the addition of £5,000 in £1 ordinary shares beyond the registered capital of £5,000.

Liquidations

Brighouse Radio Service & Equipment Co., Ltd.—Meeting January 14th, at 5, Fountain Street, Halifax, to receive an account of the winding up by the liquidator, Mr. F. V. Lambert.

Lomax & Samways, Ltd.—Meeting January 12th, at 79a, Wellington Road South, Stockport, to receive an account of the winding up from the liquidator, Mr. H. Titterton.

Western Battery & Maintenance Co., Ltd., 57-58, Finsbury Court, Finsbury Pavement, London.—First meeting to-day (December 17th) at Bankruptcy Buildings, Carey Street, W.C.2.

Bankruptcies

Edwards & Son, electrical dealers, 67, London Road, Brighton.—Receiving order made December 1st, on a creditor's petition. Public examination February 4th at the Court House, Church Street, Brighton.

H. B. Powell, wireless dealer, 10, Union Street, Hereford.—Proofs for dividend by December 23rd to the Official Receiver, Mr. O. B. Wallis, 133, Saint Owen Street, Hereford.

W. R. Kittle, refrigerator salesman, 1, Westroyd Avenue, Eccleshill, Bradford.—Application for discharge to be heard February 11th at the County Court, Manor Road, Bradford.

Spanish Electrical Industry

Ability to Meet Home Needs

ACCORDING to a Spanish trade journal, quoted in *Foreign Commerce Weekly*, the organ of the United States Department of Commerce, existing electrical manufacturing facilities in Spain are adequate to supply more than present needs of medium-size and small transformers, generators and motors in that country. Actual production of motors is equal to only about 60 per cent. of requirements, and of transformers to about 40 per cent. In 1942, 38,500 motors of more than 1½ HP and 16,500 of less than 1½ HP were made. The number of transformers manufactured totalled 1,900 with a capacity of 125,000 kW.

Spanish factories are equipped to turn out all kinds of meters, except a few special types, and have sufficient capacity to meet the country's normal annual requirements of 150,000, but they cannot meet national needs for measuring devices. At present, however, there is reported to be a deficit of about 600,000 meters as a result of war conditions.

While there are no facilities for making high-voltage apparatus, medium and low-voltage equipment can be produced in fairly large quantities.

In the less complicated field of battery and storage battery manufacture Spain is in a position not only to supply the home market but also to export some goods. Their number could be greater if more raw materials could be obtained. In 1942 the total output is calculated to have been only about half the normal capacity. Similarly it is believed that the output of electric lamps could be raised to forty millions without additional manufacturing facilities. In 1942 the number made was just over 26 millions, an increase of about seven millions on the preceding year. Owing to inferior materials the life of the lamps is said to be shorter than formerly.

Raw material shortages prevent the maximum operation of the radio industry, the capacity of which is large enough to supply the Spanish market. In 1942 only 45,000 sets were turned out against an estimated annual need of 130,000. Few valves are made in Spain and import is difficult. Some broadcasting equipment is made and practically all the telephone material used from local factories.

The production of electrical conductors is hampered by lack of copper, and that of insulated wire and cable by shortages of both rubber and lead. Plant for making insulated tubing, if operating at capacity, could make twice as much as is needed for home consumption. The output in 1942 was 2,000,000 metres.

Electric heating apparatus is supplied from local sources and there is an increasing production of refrigerators and refrigerating machinery, the use of which is expanding. Resistance coils are not made in Spain and are in short supply.

STOCKS AND SHARES

TUESDAY EVENING.

THE general tendency of Stock Exchange markets can be divided under two headings ; the gilt-edged markets are firm, their prices show a rising disposition : on the other hand, speculative stocks and shares are dull and attract little support. Until more definite news is received from the war zones, clients candidly tell their Stock Exchange brokers that they intend to sit on the fence and do nothing. With the end of the year approaching, the temptation to accumulate as much money as possible in banking accounts is again a factor ; and, with the stock markets in New York and Johannesburg both in hesitating mood, there is nothing in the overseas situation to stimulate Stock Exchange business in London.

Investment readily takes the gilt-edged stocks that come to market. Central Electricity Board issues are in favour, and senior stocks in the London Passenger Transport group have been wanted. Southern Railway 5 per cent. preference—a permanent stock—advanced to 116. The more speculative descriptions, Transport "C" for instance, and Southern preferred, are inclined to droop.

Electricity Supply

Changes in the prices of electricity supply shares are few and insignificant. For some weeks past, the market has been exhibiting a degree of strength which is only remarkable because of the depression which spread over some of the other sections in the industrial group. Repeating what has been said on many previous occasions, the investor in these shares is so satisfied with the security of his money that he rarely sells save in exceptional circumstances. The financial year of most of the companies ends with December and there is a little mild speculation as to what dividends the companies are likely to pay in respect of 1943. The decision to reduce the amount of the minimum charge to customers is expected to have no perceptible effect upon the industry's earnings.

Provincial Prospects

It is generally thought that the provincial electricity supply companies will maintain their previous rates, and that there will be no alteration in the dividends on the ordinary shares of companies such as the two Yorkshire undertakings, Midland Counties and Midland Electric Power, Newcastle-on-Tyne, North Eastern and the Scottish companies. Reference to details given in the following page will show that, at to-day's market prices, the average yield on the money is a trifle over 4 per cent., modest enough it is true, but reflecting the security of the investment and, also, the satisfaction which its holders feel with it. Clyde Valleys are 6d. harder at 40s. 6d. Northamptons, Midland Counties and Edmundsons have similarly improved.

London Companies

Less assurance is felt with regard to the possible dividend payments by the London companies. The City of London, it may be recalled, paid no interim dividend on its ordinary shares, and whether the previously 7 per cent. for the year can be maintained in respect of 1943 appears, judging from the price of the shares, to be considered a little doubtful. County of London ordinary, which paid 8 per cent., is thought likely to repeat this rate; the shares remain a firm market at 40s. 6d. which is 6d. up. South London's 7 per cent. dividend, if the price of 26s. 6d. is anything to go by, may possibly suffer a small reduction. At the quotation named the yield is 5½ per cent. on the money. British Light & Power will probably repeat the advanced dividend of 7 per cent. declared for last year.

Price Fluctuations

Shares in the equipment and manufacturing companies are a firm market. British Insulated have hardened to 5$\frac{11}{12}$, General Electrics to 88s., Siemens to 34s., Veritys to 7s. 3d., Automatic Telephone to 49s. 6d.; Crompton Parkinsons, on the increased bonus, rose to 27s. Metal Industries gained 1s. at 44s. 3d., Murex ¼ to 98s. 9d. and Enfield Cable 6d. to 59s. 6d. Telegraph Constructions have gone back to 49s., Revo to 38s. 9d. and Crabtree to 36s. 3d. The radio shares keep their previous prices. Pye deferred retain last week's rise to 25s. Oriental Telephones are 6d. up at 43s. 6d. Cable and Wireless attract a few buyers : the 5½ per cent. preference stock is 10s. better at 113. Globe Telegraph & Trust ordinary put on 6d. to 36s.

Anglo-American and dollar stocks are better, International "Tel. and Tel." being 2 points up at 16. Anglo-American deferred at 28 is 10s. higher. Last week's spurt in Brazilian Tractions brought in sellers, and the price eased off to 27⅛. Mexican Light & Power fives at 103½ have lost 3 points.

Points of Interest

Tube Investments, Ltd., did well in the year that ended on October 31st last, the full report and accounts showing that net revenue, £685,000, was £73,000 up on the previous year. An extra £100,000 is added to reserve for war contingencies, and the carry forward has gone up £80,000 to £251,000. The price of the shares is 6d. better at 89s. 6d., which, on the dividend of 20 per cent. now being paid, allows a return of £4 9s. 3d. per cent. on the money.

E. K. Cole have raised their dividend to

(*Continued on page* 829)

ELECTRICAL INVESTMENTS

Prices, Dividends and Yields

Company	Dividend Previous	Dividend Last	Middle Price Dec. 14	Rise or Fall	Yield p.c. £ s. d.
Home Electricity Companies					
Bournemouth and Poole	12½	12½	60/6	..	4 2 8
British Power and Light ..	6	7	32/–	..	4 7 6
City of London ..	7	7	28/–	..	5 0 0
Clyde Valley ..	8	8	40/6	+6d.	3 19 0
County of London	8	8	40/6	+6d.	3 19 0
Edmundsons:					
7% Pref. ..	7	7	33/6	..	4 3 7
Ord.	6	6	28/6	+6d.	3 4 3
Elec.Dis.Yorkshire	9	9	44/–	..	4 1 10
Elec. Fin. and Securities ..	12½	12½	53/6	..	4 13 4
Elec. Supply Corporation ..	10	10	46/–	..	4 7 0
Isle of Thanet ..	Nil	Nil	18/–	..	—
Lancs. Light and Power ..	7½	7½	34/6	..	4 7 0
Llanelly Elec. ..	5½	6	25/–	..	4 16 0
Lond.Assoc.Electric	4	3	22/6	..	2 13 4
London Electric	6	6	27/6	..	4 7 3
LondonPowerRed. Deb.	5	5	103½	..	4 16 7
Metropolitan E.S.	8	8	40/–	..	4 0 0
Midland Counties	8	8	39/–	+6d.	4 2 1
Mid. Elec. Power	9	9	42/6	..	4 4 9
Newcastle Elec...	7	7	31/–	..	4 10 5
North Eastern Elec.:					
Ordinary ..	7	7	32/6	..	4 6 2
7% Pref. ..	7	7	34/6	+6d.	4 1 2
Northampton ..	10	10	48/–	+6d.	4 3 4
Notting Hill 6% Pref. (£10) ..	6	Nil	10	..	—
Northmet Power:					
Ordinary ..	7	7	37/6	+6d.	3 14 8
6% Pref. ..	6	6	30/–	..	4 0 0
Richmond Elec. .	6	6	26/–	..	4 12 4
Scottish Power ..	8	8	38/6	..	4 4 4
Southern Areas ..	5	5	22/6	..	4 9 0
South London ..	7	7	26/6	..	5 5 8
West Devon ..	5	5	23/6	..	4 5 0
West Glos. ..	4½	3½	24/–	..	2 18 4
Yorkshire Elec...	8	8	42/–	+6d.	3 16 3
Overseas Electricity Companies					
Atlas Elec. ..	Nil	Nil	6/9	..	—
Calcutta Elec. ..	7*	6*	35/6	–6d.	3 7 8
Cawnpore Elec...	10	10	35/–	..	5 14 3
East African Power	7	7	33/–	..	4 4 10
Jerusalem Elec...	7	5	28/–	..	3 11 5
Kalgoorlie (10/–)	5	5	10/–	..	5 0 0
Madras Elec. ..	4*	Nil	23/–	..	—
Montreal Power	1½	1½	21	..	7 2 10
Palestine Elec."A"	4*	5*	41/–	..	2 8 10
Perak Hydro-elec.	6	7	10/–	..	—
Shawinigan Power	83cts.	90cts.	15½	..	—
Tokyo Elec. 6%	6	6	20	–2	—
VictoriaFallsPower	15	15	4½	..	3 9 7
Whitehall Inv.Pref.	—	—	24/–	–1/–	4 3 4

Company	Dividend Previous	Dividend Last	Middle Price Dec. 14	Rise or Fall	Yield p.c. £ s. d.
Public Boards					
Central Electricity:					
1955–60 (Civil Defence) ..	—	3	100	..	3 0 0
1955–75 ..	5	5	114	..	4 7 9
1951–73 ..	4½	4½	106	..	4 4 1
1963–93 ..	3½	3½	102½	+½	3 8 4
1974–94 ..	3½	3½	99	+½	3 5 8
LondonElec.Trans. Ltd.	2½	2½	97	..	2 11 3
London & Home Counties 1955–75	4½	4½	111	..	4 1 1
Lond.Pass.Trans.:					
A	4½	4½	117½	..	3 16 7
B	5	5	118½	+1	4 4 5
C	2½	3	65	–1	4 12 4
WestMidlandsJ.E.A. 1948–68 ..	5	5	109	..	4 11 9
Telegraph and Telephone					
Anglo-Am. Tel.:					
Pref.	6	6	115	..	5 4 4
Def.	1½	1½	28	+½	5 7 1
Anglo-Portuguese	8	8	23/6	..	6 16 2
Cable & Wireless:					
5½ Pref. ..	5½	5½	113	+½	4 17 4
Ord.	4	4	76	..	5 5 3
CanadianMarconi$1	Nil	4cts.	8/6	..	—
Globe Tel. & Tel.:					
Ord.	8½*	5*	36/–	+6d.	2 15 7
Pref.	6	6	29/3	..	4 2 1
Great NorthernTel. (£10)	Nil	Nil	22½	..	—
Inter. Tel. & Tel.	Nil	Nil	16	+2	—
Marconi-Marine..	7½	7½	32/3	..	4 13 0
Oriental Tel. Ord.	16	10	43/6	+6d.	—
Telephone Props.	6	Nil	17/–	..	—
Tele.Rentals(5/–)	10	10	11/6	..	4 7 0
Traction and Transport					
Anglo-Arg.Trans.:					
First Pref. (£5)	Nil	Nil	3/–	..	—
4% Inc. ..	Nil	Nil	8½	..	—
Brit.Elec.Traction:					
Def. Ord. ..	45	45	1045	..	4 6 4
Pref. Ord. ..	8	8	175	..	4 11 5
Bristol Trams ..	10	10	52/–	..	3 17 0
Brazil Traction ..	$1	$1½	27⅜	–¼	6 10 0
Calcutta Trams..	5½	6¼	35/6	–1/6	3 13 5
Cape Elec. Trams	5	6	24/–	..	5 0 0
Lancs.Transport	10	10	44/3	..	4 10 4
Mexican Light:					
1st Bonds ..	5	5	103½	–3	4 16 7
Rio 5% Bonds ..	5	5	106½	..	4 14 0
Southern Rly.:					
5% Prefd. ..	5	5	77	–¼	6 10 0
5% Pref. ..	5	5	116	+1	4 6 2
T. Tilling ..	10	10	53/6	..	3 14 8
West Riding ..	10	10	44/–	+1/6	4 11 0

(*Continued on next page*)

* Dividends are paid free of Income Tax.

Company	Dividend Previous	Dividend Last	Middle Price Dec. 14	Rise or Fall	Yield p.c. £ s. d.
Equipment and Manufacturing					
Aron. Elec. Ord.	10	15	55/–	..	5 9 1
Assoc. Elec.:					
Ord.	10	10	49/–	+6d.	4 1 8
Pref.	8	8	38/6	..	4 3 1
AutomaticTel.&Tel.	12½	12½	56/3	+9d.	4 10 0
Babcock & Wilcox	11	11	47/6	..	4 12 5
British Aluminium	10	10	47/–	–3d.	4 5 1
British Insul. Ord.	20	20	5½/–	+⅛	3 14 9
British Thermostat (5/–)	18½	18½	19/–	..	4 17 4
BritishVac.Cleaner (5/–)	15	30	26/6	..	5 13 5
Brush Ord. (5/–)	6	8	8/6	..	4 14 2
Burco (5/–)	15	17½	15/6		5 13 0
Callender's	15	20	98/–	..	4 1 8
ChlorideElec.Storage	15	15	80/–	..	3 15 0
Cole, E. K. (5/–)	10	15	26/6	..	2 16 7
Consolidated Signal	17	24	5⅝	..	4 5 1
Cossor, A. C. (5/–)	7½*	10*	22/3	..	2 5 0
Crabtree (10/–)	17½	17½	36/3	–6d.	4 16 7
Crompton Parkinson Ord. (5/–)	20	22½	27/–	+6d.	4 3 4
E.M.I. (10/–)	6	8	27/9	+3d.	2 17 8
Elec.Construction	10	12½	50/–	..	5 0 0
Enfield Cable Ord.	12½	12½	59/6	+6d.	4 4 0
English Electric	10	10	46/6	..	4 6 0
EnsignLamps(5/–)	25	15	20/–	–½	3 15 0
Ericsson Tel. (5/–)	22*	20*	51/–	..	1 19 3
Ever Ready (5/–)	40	40	38/6	..	5 4 0
Falk Stadelmann	7½	7½	32/–	..	4 13 9
Ferranti Pref.	7	7	29/6	..	4 15 0
G.E.C.:					
Pref.	6½	6½	31/6	..	4 2 6
Ord.	17½	17½	88/–	+6d.	3 19 7
Greenwood&Batley	15	15	41/3	..	7 5 9
HallTelephone(10/–)	12½	12½	25/–	..	5 0 0
Henley's (5/–)	20	20	25/–	–3d.	4 0 0
4½% Pref.	4½	4½	23/–	..	3 18 3
Hopkinsons	15	17½	60/–	..	5 16 8
India Rubber Pref.	5½	5½	21/6	..	5 2 4
Intl. Combustion	30	30	6½	..	4 16 0
Johnson & Phillips	15	15	66/6	..	4 10 3
LancashireDynamo	20	22½	92/–	..	4 18 6
Laurence,Scott(5/–)	15	12½	12/6	..	5 0 0
London Elec. Wire	7½	7½	33/–	..	4 11 0
Mather & Platt	10	10	51/3	..	3 18 9
Metal Industries(B)	5	8	44/3	+1/–	3 12 2
Met.Elec.CablePref.	5½	5½	21/3	..	5 3 6
Murex	20	20	98/9	+⅛	4 1 0
Pye Deferred (5/–)	25	25	25/–	..	5 0 0
Revo (10/–)	17½	17½	38/9	–⅛	4 10 6
Reyrolle	12½	12½	70/–	..	3 11 5
Siemens Ord.	7½	7½	34/–	+6d.	4 8 3
Strand Elec. (5/–)	7½	10	7/9	..	6 9 0
Switchgear&Cowans (5/–)	10	20	18/–	..	5 11 1
T.C.C. (10/–)	5	5	18/9	..	2 13 4
T.C. & M.	10	10	49/–	–1/–	4 1 8
TelephoneMfg.(5/–)	9	9	11/–	–6d.	4 1 10
Thorn Elec. (5/–)	20	20	21/9	..	4 12 0
Tube Investments	20	20	89/6	+6d.	4 9 3
Vactric (5/–)	Nil	Nil	14/9	+6d.	—
Veritys (5/–)	7½	7½	7/3	+6d.	5 3 5
Vickers (10/–)	10	10	17/9	..	5 12 8
WalsallConduits(4/–)	55	55	45/–	..	4 17 9
Ward & Goldstone (5/–)	20	20	27/3	..	3 13 5
WestinghouseBrake	10	12½	65/–	..	3 17 0
West, Allen (5/–)	7½	7½	6/9	–3d.	5 11 2

* Dividends are paid free of Income Tax.

Stocks and Shares (*Continued from page* 827)

15 per cent. (two years ago it was 7 per cent.). The announcement had no effect upon the price, which is 26s. 6d. E.M.I. strengthened to 27s. 9d. A line of the company's 6 per cent. redeemable preference shares came on offer at 24s. 6d. The company has the right to repay the issue, at 22s. 6d., on or before January 1st, 1950, upon giving three months' notice. Other shares to come to market have been 5,000 Lancashire Dynamo at 92s. 9d.

J. & F. Stone Lighting

J. & F. Stone Lighting & Radio shares are quoted ex the increased dividend of 6 per cent. just paid. At 5s. 10½d., the current price, the yield on the money is a little over 5 per cent. At the meeting last week, the chairman referred to the further strengthening of the financial position and said that a particularly satisfactory feature was the fact that they had been able to maintain the stock in trade. The company's previous ordinary capital of £215,000 was raised five years ago to £400,000, in 1,600,000 shares of 5s. each. There is also £160,370 in 6 per cent. cumulative preference shares of £1. At one time in 1940 the price of the ordinary dropped to 1s. and the present quotation is the best since 1938.

Ensign Lamps

That there might be a reduction in the previously-paid 25 per cent. dividend on Ensign Lamp shares was expected, but the decrease to 15 per cent. was greater than had been looked for. The price of the shares, from being 22s. 6d., gave way to 20s., and was rather nominal at that. The company had paid 25 per cent. annually for five consecutive years and the interim dividend was maintained at 10 per cent., so that the final 5 per cent. was disappointing. The company has an issued capital of £75,000 in 5s. shares and at the meeting last December the chairman stated that, subject to no unforeseen factors in future war and trade situations, there was every reason to suppose that the development of the past few years would continue. Rumour has it that one of the well-known radio companies has been angling for control of Ensign Lamps, Ltd., but nothing has transpired to confirm or to disprove the gossip.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (1s. each) may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2.

ARROW Electric Switches, Ltd.—" Manually or automatically resettable electric snap action switch." 6779/41. June 14th, 1940. (557543.) " Electromagnetic switches." 3874/42. March 24th, 1941. (557546.) " Overload switches." 13827/42. June 14th, 1940. (Divided out of 557543.) (557576.) " Electric snap action switch." 3790/43. June 14th, 1940. (Divided out of 557543.) (557577.)

Bendix Aviation Corporation.—" Time limiting devices for electric engine starters." 7013/42. May 31st, 1941. (557560.) " Electrical connections for shielded conductors." 6797/42. May 6th, 1941. (557625.)

H. A. Brassert & Co., Ltd., and R. Nissim.—" Electric arc furnaces." 6976. May 22nd, 1942. (557538.)

H. A. Brassert & Co., Ltd., J. Miles and R. Nissim.—" Furnaces." Cognate applications 6672/42 and 14405/42. May 16th, 1942. (557484.) " Furnaces." Cognate applications 7847/43 and 7848/43. May 16th, 1942. (Divided out of 557484.) (557508.)

British Insulated Cables, Ltd., W. C. Handley, J. C. Quayle and E. G. McLeod.—" Electric condensers." 12323. September 1st, 1942. (557503.)

British Thomson-Houston Co., Ltd.—" Elastic fluid turbines." 6802/42. May 24th, 1941. (557490.) " Sockets for tubular electric lamps." 7696/42. June 6th, 1941. (557496.) " Gas-filled electric discharge devices and circuits therefor." 2224/42. February 21st, 1941. (557516.) " Electric motor control systems." 2268/42. February 20th, 1941. (557517.) " Electromagnets." 6870/42. May 24th, 1941. (557585.) " Electric lamps and methods of manufacturing them." 9394/42. July 12th, 1941. (557598.) " Refrigeration apparatus." 11384/43. August 23rd, 1941. (557605.)

British Thomson-Houston Co., Ltd. (General Electric Co.).—" X-ray tubes." 7251. May 28th, 1942. (557631.)

British Thomson-Houston Co., Ltd., H. R. Ruff and L. J. Davies.—" Arrangement for the indication of atmospheric moisture." 7963. May 3rd, 1940. (557613.)

British Thomson-Houston Co., Ltd., H. R. Ruff and M. G. Clarke.—" Means for the detection of the presence of moisture in an atmosphere." 10986. August 28th, 1941. (557614.)

British Thomson-Houston Co., Ltd., H. R. Ruff and R. F. Weston.—" Means for the remote indication of the presence of moisture in an atmosphere." 10987. August 28th, 1941. (557615.)

J. W. Dalgleish, F. Higginbottom and Pye, Ltd.—" Electrically heated ovens." 9272. July 4th, 1942. (557597.)

Electric Household Utilities Corporation.—" Ironing machines." 5496/41. December 6th, 1940. (557509.)

Elliott Bros. (London), Ltd., and H. D. Hawkes.—" Magneto generators." 6597. May 15th, 1942. (557641.)

Igranic Electric Co., Ltd.—" Controllers for electric motors." 5543/42. April 28th, 1941 (557582.)

H. W. K. Jennings (Acrotorque Co.).—" Pumps, motors, compressors and the like." 7661. June 18th, 1941. (Convention date not granted.) (557510.)

E. C. Kny.—" Driving gear for electrically propelled vehicles." 6714. May 18th, 1942. (557555.)

Marconi's Wireless Telegraph Co., Ltd.—" Frequency modulation." 13521/42. September 26th, 1941. (557507.) " Filament connections for radio tubes, lamps, etc., and methods of and machines for manufacturing filaments." 6827/42. May 20th, 1941. (557529.)

J. Neill & Co. (Sheffield), Ltd., and W. L. Bower.—" Magnetic separators." 6798. May 19th, 1942. (557626.)

Pullars Electric Co. (Brighton), Ltd., J. E. Brown and T. Bowen.—" Electrical measuring instruments." 5548. April 24th, 1942. (557583.)

Self-Priming Pump & Engineering Co., Ltd., and F. J. Watson.—" Apparatus for checking the power generated by small motors." 5482. April 23rd, 1942. (557552.)

Standard Telephones & Cables, Ltd. (Western Electric Co., Inc.).—" Electron discharge devices." 4784. April 10th, 1942. (557548.)

Standard Telephones & Cables, Ltd., and G. L. Ward.—" Electrically heated soldering apparatus." 17429. May 22nd, 1942. (Divided out of 551338.) (557566.)

Standard Telephones & Cables, Ltd., A. Brown and T. A. Marshall.—" Railway signal and/or points control systems." 7000. May 22nd, 1942. (557540.)

Standard Telephones & Cables, Ltd., C. W. Earp and C. E. Strong.—" Ultra-high-frequency radio signalling systems." 7035. May 22nd, 1942. (557563.)

Standard Telephones & Cables, Ltd., H. Wolfson and S. C. Shepard.—" Resistance elements having a high temperature coefficient of resistance." 6786. May 19th, 1942. (557489.) " Resistance elements having a high temperature coefficient of resistance." 7001. May 22nd, 1942. (557541.) " Resistance elements having a high temperature coefficient of resistance." 7002. May 22nd, 1942. (557559.)

A. H. Stevens. (Electronic Laboratories, Inc.).—" Electrical systems, particularly systems for converting direct current into alternating current." 6877. May 20th, 1942. (557533.)

W. W. Triggs (Alncin, Inc.).—" Composite light transmitting devices and method of manufacturing the same." 2175. February 18th, 1942. (557515.)

Wagner Electric Corporation.—" Brake control mechanism." 6863/42. May 24th, 1941. (557531.)

Westinghouse Electric International Co.—" Automatic reclosing circuit-breaker systems." 12271/42. October 18th, 1941. (557608.)

W. Worth.—" Temperature control apparatus." 535/42. January 4th, 1941. (557616.)

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

Contracts Open

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia. — QUEENSLAND. — February 11th, 1944. Brisbane City Council. Two (or alternatively three) 600-V mercury arc rectifiers, each of 1,000 kW rating, together with transformers, high-voltage switchgear, automatic control gear, DC switchgear, supervisory control gear and accessories. Spec. £2 2s. General manager, Department of Transport. (*Tenders*, Melbourne.)

COMMONWEALTH.—January 4th. P.M.G's Department. Multiple twin braided cable, Sch. C.4278. Switchboard keys, Sch. C.4267.

Leyton.—January 6th. Corporation. Traction batteries. (See this issue.)

Manchester.—January 7th. Electricity Committee. Ash sluicing plant, telphers, etc. (See this issue.)

New Zealand.—January 31st. Auckland City Council. Electrically driven pumping plant, capacity 8,000,000 gallons per day, for Lower Nihotupu dam.

Plymouth.—January 1st. Electricity Department. Heat insulating material for steam pipework, feedwater pipework, boiler drums and valves. (December 10th.)

Orders Placed

Birmingham. — Electricity Committee. Accepted. Condenser tubes.—Yorkshire Copper Works. Cables.—Callender's. Reconditioning of a section of a turbo-alternator.—C. A. Parsons. Spare parts for boiler plant.—Laurence, Scott & Electromotors. Fire protection equipment.—Newalls Insulation Co.; Atlas Sprinkler Co. Spare parts for switchgear.—A. Reyrolle.

Cardiff.—Transport Committee. Accepted. Cadmium-copper trolley wire (£878).—British Insulated Cables, Ltd.

Electricity Committee. Accepted. Drag scraper equipment for coal plant (£500).—Fraser & Chalmers.

Glasgow. — Police Committee. Accepted. Electrical work in new wireless workshop at Central Police Office (£215 plus usual percentage addition).—Corporation Electricity Department.

London.—POPLAR. Electricity Committee. Accepted. Battery for tower wagon (£119).—Young Accumulator Co.

SOUTHWARK.—Electricity Committee. Accepted. Transformer (£137).—County of London Electric Supply Co. Low-voltage switchboard (£66).—Lucy & Co. Cable (£120).—W. White & Co. Boiler repairs (£61).—Anglo-Swedish Electric Welding Co. Cable drums (£71).—Scottish Cables.

HAMMERSMITH.—Electricity Committee. Accepted. Repairs to 200-kVA transformer damaged by water (£105). British Electric Transformer Co.

Contracts in Prospect

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Brighton.—Alterations and electric lighting, hospital clinic; borough engineer.

Machine joinery shop, Howard Terrace; A. A. Taylor.

Bury.—Works additions; F. Tomlinson, builder, Limefield, Bury.

Cardiff. — Clinic, City Lodge Institution (£2,000); city engineer.

Chesterfield.—Completion of church (£5,000); Rev. S. R. Boden, St. Augustine's Vicarage.

Chinley.—Parish hall; Capt. J. Atkinson, White Knowle, Chinley.

Coatbridge.—Garages for John Alexander & Sons, Coats Street (£600); manager.

Cockermouth.—Farm workers' houses; T. Armstrong, builder.

Coventry.—Parish hall; Rev. Fr. P. Smith, Stivichall, Coventry.

Darlington.—Additions to Dodmire School for kitchen (£2,550); borough engineer.

Durham.—Shelter, Horsehole (£500); city engineer.

Ealing.—Works additions; C. & S. Construction Co., Ltd., building contractors, Worton Road, Isleworth.

Fifeshire.—Cooking depot, Dunfermline for 2,000 meals a day; architect, County Council, Cupar, Fife.

Foleshill.—Church hall; Rev. E. V. Beeny, St. Laurence's Vicarage.

Gateshead. — Canteen, etc., for Huwood Mining Machinery, Ltd., Team Valley Trading Estate.

Greenock.—Rebuilding of Central Picture House recently destroyed by fire; manager.

New building for Salvation Army; captain in charge, Greenock.

Inverness.—Rebuilding of St. Columba's Church; minister.

Isle of Wight.—Kitchen at Gatten and Lake School, Newport (£1,428); G. H. Williams and Son, builders, Wootton Bridge, Newport.

Jarrow.—Premises in Field Terrace to be converted into a nurses' hostel; borough engineer, Town Hall.

Kirkham.—Houses for U.D.C.; J. Miller, architect, 14, Chapel Street, Preston.

Leeds.—Boiler house and alterations at North Lodge Institution, Beckett Street (£8,050); Armitage & Hodgson, Ltd., contractors, Camp Road Mills, Leeds, 7.

London.—FINSBURY.—Day nursery, Donegal Street (£3,483); G. B. Farrer & Co., builders, 193, Whitechapel Road, E.1.

LEWISHAM. — Wartime nursery at Lee; borough engineer, Council Offices, Town Hall, Catford, S.E.6.

Manchester.—School kitchen, Parry Street; J. B. Brez, chief surveyor, Education Offices, Deansgate, Manchester, 3.

Mansfield.—Dairy, Westfield Street; Mansfield, Sutton and District Co-operative Society, Ltd., Stockwellgate.

Moston.—Works additions, P. W. Churchman, architect, 3, Covelly Drive, Hillside, Southport.

Garage, Moston Lane, D. Middleton & Son, haulage contractors; Moston Brick & Building Co., Kenyon Lane.

Newcastle - on - Tyne.—Additions, including welding shed, Lawrence Road, for the Limmer & Trinidad Lake Asphalt Co., Ltd.; Bewley & Scott, Ltd., builders, Dunston-on-Tyne.

Canteen, Bath Lane, for John Sinclair, Ltd.; J. W. Taylor, architect, Norwick Union Chambers.

North Riding.—Improvements to Richmond (Yorks) Institution (£1,000); county architect, County Hall, Northallerton.

Pembrokeshire.—Reconstruction of buildings at Blaenllwydiarth, for War Agricultural Executive Committee; W. H. Jones, executive officer, Penllwyn, Barn Street, Haverfordwest.

Poole.—Meals kitchens at six schools; J. R. Barron, borough engineer, Municipal Buildings, Park Gates East.

Prudhoe - on - Tyne.—British Restaurant at Mickley; U.D.C. surveyor.

Radcliffe.—Mill additions; Lancashire Cotton Corporation, Ltd., Blackfriars House, The Parsonage, Manchester.

Rotherham.—Office block, Northfield Road; Refined Stainless Steel Co., Ltd.

South Westmorland.—Farm workers' houses for R.D.C.; Nicholson & Wright, Lancaster.

Stockport.—Offices; W. H. Crossley & Son, Worrall Street, Edgeley.

Canteen, etc., at Mersey Mills, Portwood, for Barnshaw & Co., Ltd.; E. B. Jones and Rawlinson, Ltd., builders, Leaf Square, Pendleton, Salford.

Extensions to fire station, Hooley Range, Heaton Moor; W. F. Gardner, borough surveyor.

Installation of electric washing machines in Bann Street public wash house; W. F. Gardner, borough surveyor.

Warrington.—Buildings; H. Bibby & Co., Buttermarket Street.

Additions, Infirmary, Town Hall Gardens; governors.

Fitting shop, Bank Quay; British Aluminium Co., Ltd.

Wiltshire.—Staff accommodation at Pewsey Colony (£1,284); Syms & Son, building contractors, 132, London Road, Calne.

Worksop.—Mill extensions; Beard's (Millers), Ltd., Dukeries Flour Mills.

The Electron Microscope

Aid for Research in Many Industries

DR. E. H. RAYNER, late head of the high-voltage testing department of the National Physical Laboratory, Teddington, recently lectured at the British Institute of Radiology on the electron microscope. Dr. Rayner prefaced his address by recalling that, in 1876, Abbé, the celebrated microscopist, who recognised the limitations of the glass microscope, expressed the hope that at some future time, by a process then quite unknown, the existing barriers to human vision might be removed. To-day, more than sixty years later, that hope had been fulfilled by the development of the electron microscope, an achievement brought about by the closest co-operation between physicists and engineers.

The lecturer described the elements of the glass microscope and explained how the useful magnification obtainable was limited by the resolving power of the objective lens of the optical system that determined the fineness of the details which could be made visible in the object under view. It was dependent on a factor known as the numerical aperture of the object lens which, in turn, depended on the wave-length of the light used and the wideness of the cone of rays which the lens system was able to pick up from the specimen. In the best glass microscope the limit of useful magnification was about 1,200 to 1,500. Larger magnifications were possible, but they did not enable any more detail to be seen.

Some improvement became possible by employing blue light, or even ultra-violet light, but the use of the latter was attended by considerable experimental difficulty. The radiation was invisible, the lenses needed to be of quartz since glass absorbed ultra-violet rays, and focusing was possible only by the tedious process of trial and error.

By means of lantern slides, the lecturer showed how electrostatic and magnetic fields could be used to form electron images of semi-transparent microscopic objects. Such electron beams under high accelerating voltages had an associated wave-length many times less than that of the visible so that images could be resolved with magnifications up to 50,000 or more and might be recorded by photography.

Numerous illustrations showing bacteria being attacked by anti-bodies and various types of disease virus hitherto unseen were shown. Photographs of large molecules of polymerised compounds were exhibited on the screen. In conclusion, Dr. Rayner expressed the opinion that research in almost every industry would be materially assisted by this new instrument and he considered that it would be difficult to predict the extent to which the coming generation would benefit from developments now taking place.

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